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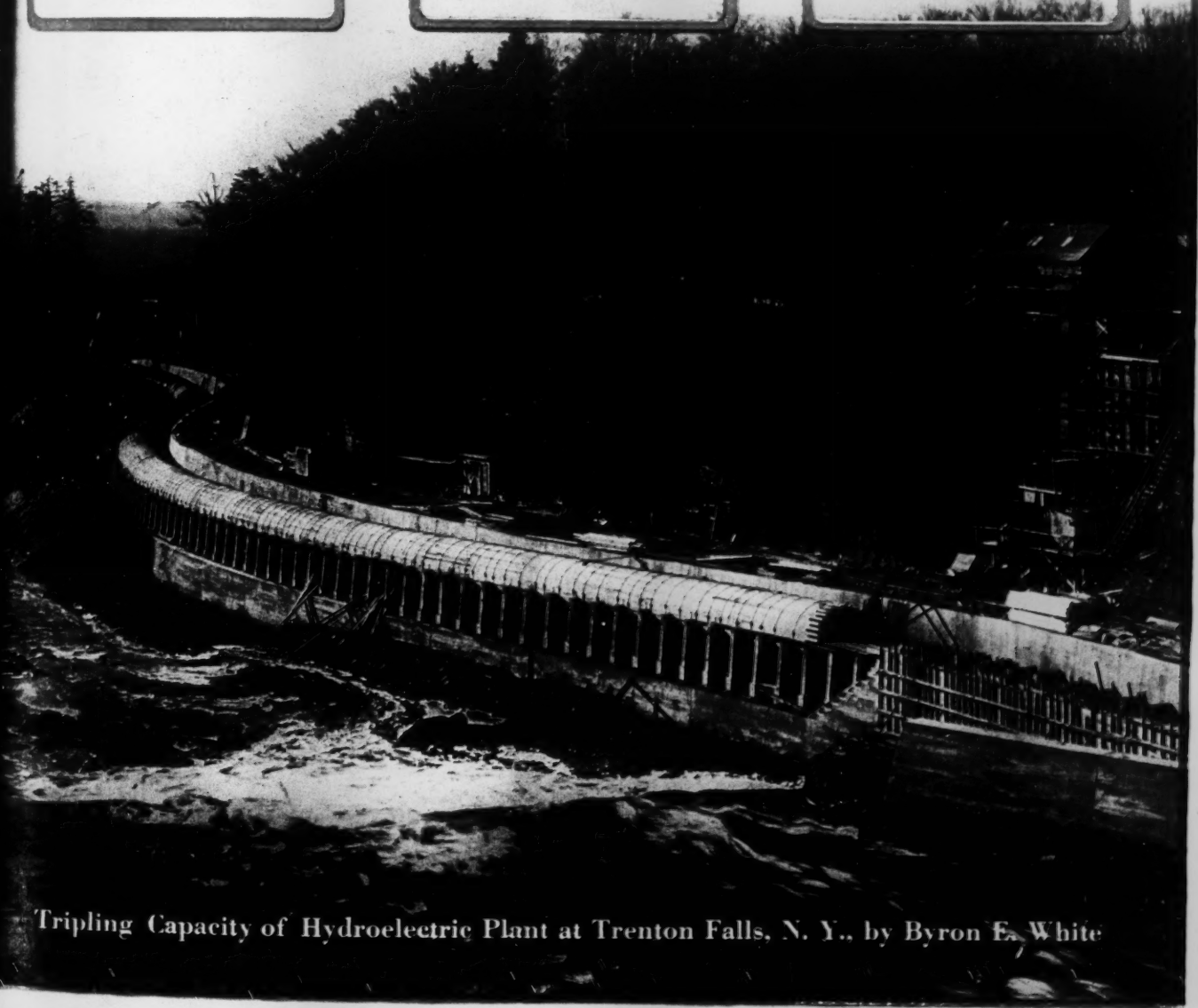
May 30, 1918

How Army Hospitals Are Being Protected Against Fire

Rational Basis for Determining Working Capital
By GASKELL S. JACOBS

Rapid Construction of Wooden Army Warehouses at Atlantic Port



Tripling Capacity of Hydroelectric Plant at Trenton Falls, N. Y., by Byron E. White

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AND CONTRACTING

E. J. Mehren, *Editor* — Charles Whiting Baker, *Consulting Editor*

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Even War Has Its Benefits

ONE did not need to be a close student to appreciate that our spendthrift habits of the recent past were at the root of many of the ills from which we, as a nation, suffered. Beside poverty and illness, we can trace discontent and many of the difficulties of industry to our proneness to self-indulgence, whether in eating or drinking, or in ostentation and harmless but wasteful amusement. The third Liberty Loan suggests the probability of the widespread beginnings of thrift. Four million five hundred thousand persons subscribed to the first loan, 9,500,000 to the second and 17,000,000 to the third. Moreover, the sale of thrift and war-savings stamps has met with remarkable success. If we learn thrift during this war, the conflict, in addition to removing the menace of German autocracy, will bring a great collateral benefit to offset its horrible cost.

Cars for Road Work Provided

THE agitation for preferential treatment of highway material in the distribution of the car supply has at last borne fruit. The government order, printed in the news section of this issue, is the first systematic move which has been developed to get the much needed cars without jeopardizing war industries transportation. All departments interested in roads or in the shipment of road materials are coördinated, the action following to a marked degree the constructive resolution prepared by the Highway Industries Association and passed at the April meeting, in Chicago, of the United States Chamber of Commerce. It is believed that the newly formed committee will approve a large amount of the more necessary work, and that it will now be possible to put the maintenance and repair programs which have been hampered by previous rulings on a basis that will utilize the investment already made in the highways.

The New Spirit in Shipbuilding

LAST winter the accepted attitude on shipbuilding was pessimistic. There were good reasons for it. With the coming of spring launchings became relatively frequent and the partial relief of railroad congestion allowed shipbuilding materials to come through in larger volume. The conditions are now distinctly better. Nevertheless, the thing that has changed in shipbuilding is not so much the physical situation as the mental attitude of those in charge of the work. Then everyone seemed to be looking for a scapegoat. Labor was more often selected than any other factor. Today we find the Director General of the Emergency Fleet Corporation commending the attitude of the workers most highly and by his own optimism and enthusiasm carrying to the workers in the yards the feeling that they are doing a great piece of work, that they are really contributing to the winning of the war. Friendly rivalry has been introduced and East vies with West for riveting and launching records. The spirit of the game has been introduced and the players are being led, not driven. If someone should play his position badly, we will look now for friendly advice, for good coaching, not for fault finding which takes the spirit out of the team. Surely, the principal improvement is mental, and it means much to the success of the shipbuilding program.

Military Drill for College Students

IT IS difficult under present circumstances to estimate properly the importance of the plan by which, beginning with the next college year, the Government will provide military instruction for college students. The character of military training in the land-grant colleges is well known. While it does some good, those who have had the training must concede that they cannot lay claim to either extensive military knowledge or any considerable disciplinary benefit. Manifestly, the object of the training is not to turn out finished soldiers; and by what skill the men may have acquired the Government has already profited in the present emergency. To approximate the benefits, however, which would be derived from a universal-military-training system, the discipline would have to be much more severe, the drill more intensive. Without a doubt, the new ruling by which military instruction will be available to all colleges which are enabled to enroll 100 or more students for drill, contemplates benefits going far beyond those now derived from the military work in the land-grant colleges. The new arrangement is a long step toward the much-desired universal military training. While it is taken to provide for the present emergency, no one can doubt that the colleges and the country at large will want to continue the plan after peace is declared. The experiment will start under favorable auspices—in the colleges where the spirit has been particularly good and during war times. If we sense their spirit correctly the engineers of the country will hope that it will prove so successful that it will become a convincing object-lesson of the value of universal military training.

Utilizing the Nation's Man-Power

AT LAST the essential step in that scientific readjustment of industry, without needless idleness of workers or plants, for which this journal has contended is forecast by the Provost-Marshall General. There is no progress made by closing down nonessential industries where the workers are not used for essential purposes. Yet the shifting of labor from unnecessary to badly-needed industries has so far been largely accomplished by closing down the former through priority rulings and allowing the latter to bid against the rest of the country, including one another, in the open market for labor. Mitigated to a great degree by scientific assistance from the Government in labor matters, the conditions resulting from this lack of a broad employment policy could not have been satisfactorily adjusted without something resembling the present action. The curtailment of less necessary production and the distribution of labor to war industries may soon be accomplished, without lost time or idleness, by bodily shifting the labor itself, leaving the plants of less importance with reduced forces and thus in turn automatically reducing their demands for raw materials and transportation. It is to be hoped that the United States Employment Service, assisting the draft board machinery, will play a large part in the reassignment of the registered men of the country, who are the most important section of our labor supply. That engineers, contractors and manufacturers in the construction field will, though they employ directly but a small portion of the men affected, do everything in their power to assist in working out the new ruling, may be taken for granted.

The Federal Railway Administration's Attitude Toward Patents

IN THE recent negotiations over the contracts for cars and locomotives, the Federal railway administration requested that bidders waive all royalties on patented appliances. Furthermore, it required manufacturers of car and locomotive specialties desiring to do business to submit their cost sheets, with the intimation that they were to be cut down to a fixed limit of profits.

There have been, without doubt, certain abuses in connection with the railway supply business which ought not to continue under the Federal control. But this condition is by no means typical of the entire railway supply business; and if, in order to suppress this graft, a barrier is to be erected against the adoption of new inventions in the railway field, the remedy will work more injury than the disease.

It is by no means to be assumed that we have reached an end of all improvements in the art of transportation. On the contrary, there never was a time when changes in design and construction were more rapid, and when there was more need of keeping the door wide open for progress. The Federal railway officials have the power to close this door to further improvements in the field of railway transportation, and they will do so effectively if they bar the payment of royalties or other compensation for the use of patented inventions. The adoption of such a policy can proceed only from ignorance of the importance of invention to transportation, and of the necessity of patent protection if such development is to continue.

The patent protection and the right to compensation which it secures are necessary not merely to encourage the inventor, but to protect the manufacturer who invests the necessary capital to develop a new invention on a practical basis and who undertakes the largest and most expensive task of all—educating the public to an understanding of its value. If the policy of eliminating all compensation for patented devices is to be put into effect it may not reduce the number of paper inventions filed in the patent office, but it will prevent the investment of capital in the development of meritorious devices.

Motor Trucking Provides Facilities at Industrial Plants

INTERNAL transportation methods which provide for handling materials and supplies between the several shops and departments of large manufacturing and industrial plants have an important influence upon the efficient and economical operation of such plants. Industrial railways, locomotive cranes, motor trucks, telpher lines and other systems have been introduced extensively, but even yet in some modern plants there is waste of time, energy and money in long-distance hand trucking or makeshift methods.

A recent installation on a large scale which is described on page 1038 comprises the adoption of motor trucks and the construction of more than two miles of concrete roadways to provide for the ready operation of the trucks between the various parts of a large railway shop plant. The equipment includes both the ordinary large motor trucks as used on public roads, and the small trucks with trailers such as are being used at a number of railway freight stations and warehouses.

Service of this kind at a large plant may require a variety of movements. The problem includes the transfer of incoming supplies and materials from cars to storehouses and their distribution to the various shops, or to cars for shipment to other points. There are also inter-shop or inter-department movements such as the transfer of castings from foundries to machine shops, finished parts from machine shops to erecting shops, and of lumber from storage yards to car shops.

Paved roadways greatly improve the efficiency of such a trucking service as compared with the ordinary cinder and earth roadways of industrial plants. Naturally they provide for greater speed and greater handling power, besides eliminating the delays and wear and tear which inevitably result when trucks have to work through dust beds and mudholes. For this reason the concrete roadways throughout the plant mentioned are of special interest in the internal transportation system. It is noteworthy that these trucking roadways also take the place of the ordinary light shop tracks on which materials are moved by means of small push cars.

A somewhat different application of the system of handling material by small electric trucks with trailer trains is soon to be made at Chicago in connection with the establishment of a large group of buildings for manufacturing and industrial purposes. A central freight station will serve the entire group, and will be connected with the buildings by small tunnels having

spurs leading into the basements. A truck-and-trailer service operating in these tunnels will collect and distribute freight and supplies for the entire group, so that the individual firms will have to provide only for the loading and unloading of the trucks on their premises.

As between the two types of small motor trucks adapted for handling trailers, one acting both as motor and carrier and the other being simply a motor, it is interesting to note that the yards and terminals committee of the American Railway Engineering Association is on record as favoring the latter in railway freight-station service, where the main requirement is the movement of trains of trailers: while the former seems better adapted not only for baggage handling in passenger stations, but for industrial-plant service where movements may include single truck loads as well as the operation of trains.

Idle Time and Price Fixing

IN THE recent hearings before the Federal Trade Commission looking to the fixing of prices for newsprint paper, Henry L. Gantt, of New York, set before the commission the cost-keeping method wherein a segregation is made between those parts of the burden attributable to time, property or equipment used in manufacturing the product and those that represent idle labor, property or equipment. The method is not novel, though not generally adopted. Its wide application would be a powerful aid in the elimination of losses in industrial operations.

Some of the questions asked at the hearing would indicate that to lawyers at least the problems of cost-finding are not clear. Mr. Gantt did not contend that where prices are to be fixed allowance should not be made for return on idle equipment. He urged merely that the expense of idle time be segregated from the items attributable to the property or equipment employed in turning out the product in question. As one of the commissioners put it, the expense items due to idle machines, equipment and labor should be put in a "uniform" so that they may be recognized for what they are.

Every manager who really knows what he is doing must distinguish between wastes due to mismanagement on the one hand and those due to the peculiarities of the business on the other. Machines may be idle for lack of material, the delays being solely attributable to inefficient planning in the ordering and routing of goods or to under-equipment in a given department. On the other hand, a business may have to provide for a seasonal peak, and the management thus be forced to have an investment in machines idle during a large part of the year.

In a competitive business these preventable wastes are spread over the actual production and put into the selling price only in so far as the competitive market permits. And even if the market is such that all the expense of idleness can be covered in the selling price, and a good profit put on in addition, the manufacturer loses much if he fails to segregate his idleness expense—he loses the corrective influence of such segregation.

Furthermore, the importance of the question of segregation or nonsegregation is evident in a proceeding intended to determine the fair price of a commodity. Apparently, therefore, the decision of the Federal Trade Commission in fixing the price of newsprint paper will be well worth careful scrutiny.

While rate-fixing on public utilities has long been with us, fixing of prices for industrial products is a war innovation. So far we know little regarding the principles followed in fixing the prices of coal and wheat. Even these products are in a category distinct from those produced in mills and factories. The Federal Trade Commission, then, is breaking new paths in fixing prices, and its work should be closely watched.

Hospital Fire Protection, Though Good, Could Well Be Better

STRUCTURAL revisions in the design of the new army hospitals and improvements in those hastily built in the early days of the war have materially alleviated the fear expressed in these columns some months ago that the safety of the helpless sick and wounded was seriously imperiled by the possibility of rapidly spreading fire. The changes, noted in the article on p. 1054 of this issue, are vital. With few exceptions, such as the lack of projecting fire walls at the corridor stops and the actual use, not warranted by the designs, of non-fireproof partitions in some of the wards, the modified plans are practically up to the specifications for emergency housing recently adopted by the National Fire Protection Association. The fact remains that a higher degree of protection would have been afforded by the use of fire-resistive material for the walls, porches and corridors.

Fire protection is relative. There is no absolute standard which can be applied to all classes of occupancy and supervision. And even for field conditions the best that can be hoped for is to reduce the chances of a conflagration starting or spreading. In the army hospitals the occupancy demands the highest type of protection, but this requirement is modified to some extent by a military supervision which insures ample watchfulness throughout the entire 24 hours. There is therefore justification for putting a certain reliance in the watchfulness of humans and the efficacy of mechanical devices, to detect the start of any fire, and in hindrances such as open spaces, fire stops and fighting apparatus, to prevent its spread. The buildings have, let us say, 85 per cent. protection. Stucco or hollow-tile walls, such as are used in some of the newer hospitals, would increase that to 90 per cent.

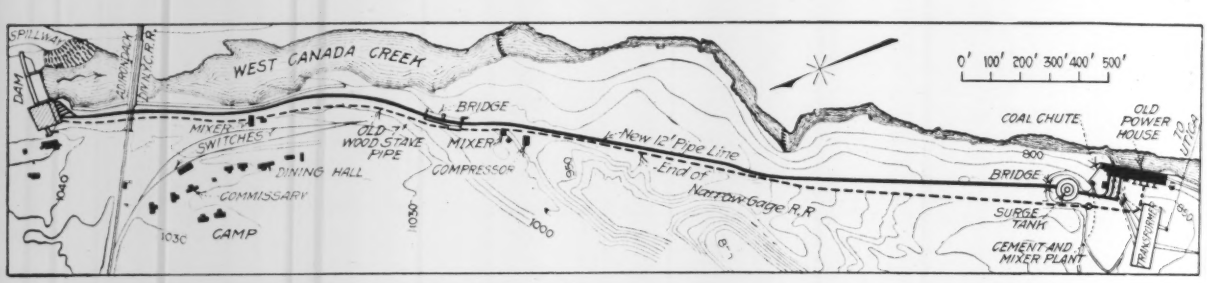
Such slight additional protection was rejected in the general design because the army officers decided the cost excessive for the benefit gained, and because they were convinced that material and labor were not available for the plastering and masonry work required. In this latter opinion they were specifically contradicted by the interests promoting such materials, so that it comes to a question of fact which might better have been settled by actual test. The new hospitals are not fire traps. In all probability, they will come through the war without serious mishap, but it remains to be proved that a desirable degree of additional protection could not have been achieved with sufficient speed and economy to warrant its adoption in the later designs.

Trebling the Capacity of a Hydro-Electric Plant During Operation

Trenton Falls Development in Adirondacks Increased from 8800 to 27,000 Horse Power by Utilizing Surplus Intakes in Existing Dam and Adding Pipe-Line and Power-House Equipment

By Byron S. White
Resident Engineer, Utica Gas & Electric Co., Trenton Falls, N. Y.

PROVISIONS for future extension of the Trenton Falls development of the Utica Gas & Electric Co., made when the plant was built 17 years ago, are now being utilized. Old 5-ft. intake pipes and sluice-ways purposely placed in the dam are being connected to a manifold, and thence to a new ¾-mile 12-ft. pipe-line, partly of wood staves and partly of steel, which leads to an addition to the power house. When completed the new plant will develop three times as much power as the old. Construction in 1914 of the Hinckley barge canal reservoir for the State of New York, about four miles upstream of the plant, equalized the flow of West Canada creek, on which the development is located, to such an extent that the increased power could be utilized. The old plant is being run during the reconstruction, and will be tied into the new one as soon as the full utilization of the additional power can be made, which is anticipated to be the middle of the coming summer. The old one will be utilized in the future at times of high water and as a standby. Construction was carried on under adverse conditions of labor and purchase of materials and also right through the worst winter known to the present generation.



IN LONG GORGE NEW PIPE LINE FROM DAM TO POWER HOUSE PARALLELS OLD LINE

The Trenton Falls plant is situated at Trenton Falls, Oneida County, N. Y., on West Canada Creek which rises in the southwestern Adirondack region and flows southwesterly to Trenton Falls and thence southeasterly into the Mohawk River at Herkimer, N. Y. The drainage area above Trenton Falls is about 375 square miles, and the mean flow about 1175 cu.ft. per second. Power is supplied in the upper Mohawk valley region to municipal and industrial plants. The company had acquired most of the Hinckley reservoir area before the state appropriated the lands and had planned to build there a large storage reservoir, but the necessary equalization of flow has been brought about by the construction of the state reservoir, which has a capacity of about 3,500,000,000 cubic feet.

The old plant consists of four vertical-shaft General Electric units of 1200 kw. capacity, generating 60 cycle, 2200 volt, 3 phase, alternating current. The I. P. Morris Co. turbines are of the radial outward-flow type, with cylinder gates, rated at 2200 hp. at 360 r.p.m., under 264 ft. gross head. There are also exciters driven by small turbines and Pelton wheels. The greater part of the 2200-volt current is stepped up to 22,000 volts by air-blast transformers and transmitted over lines to Utica and to Rome.

Head is created behind a concrete dam approximately 60 ft. high and about 288 ft. long at the crest, spanning a narrow rock gorge above the series of four falls which give the place its name. A 7-ft. pipe line, about 3800 ft. long, conducts the water to the turbines. This line consists of about 2800 ft. of wood-stave pipe of long-leaf yellow pine, the balance being steel, with a 7-ft. header at the rear of the power house, from which four 48-in. connections lead to the several water wheels. The power house is situated in a very narrow part of the gorge; this required the excavation of a large amount of rock to provide the site for both the original station and the adjoining extension. About 200 ft. above the junction of the steel pipe and the header is a 7-ft. vertical steel standpipe 180 ft. in height directly connected to the steel pipe line.

The new station will utilize the existing dam, but otherwise is entirely new and independent of the old plant. The new work consists of steel racks in front of the four existing sluice pipes in the dam, a steel manifold connecting to existing pipes through the dam, new gate valves and gate house, a 12-ft. wood-stave and steel pipe, a surge tank, and the extension of the power house to contain three units each of 9000 hp. capacity under 264 ft. gross head, together with an outdoor high-tension transformer and switching station.

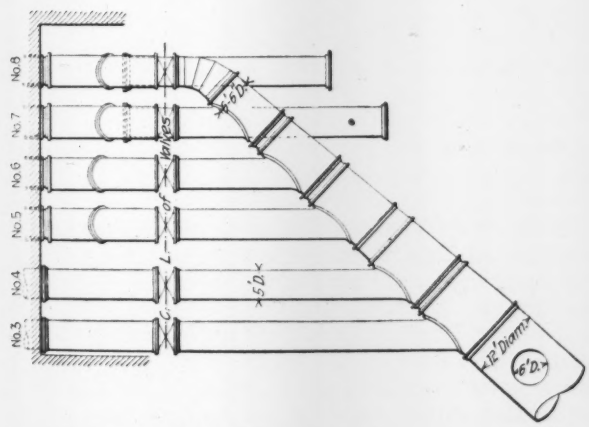
The surplus intake and sluice pipes in the dam comprise two 5-ft. flanged cast-iron pipes provided with steel racks, and originally intended to supply a proposed extension to the plant, and, at an elevation 9 ft.

lower, four 5-ft. bell and spigot cast-iron sluice pipes without racks. All the pipes are closed by 5-ft. sluice gates at the upper face of the dam.

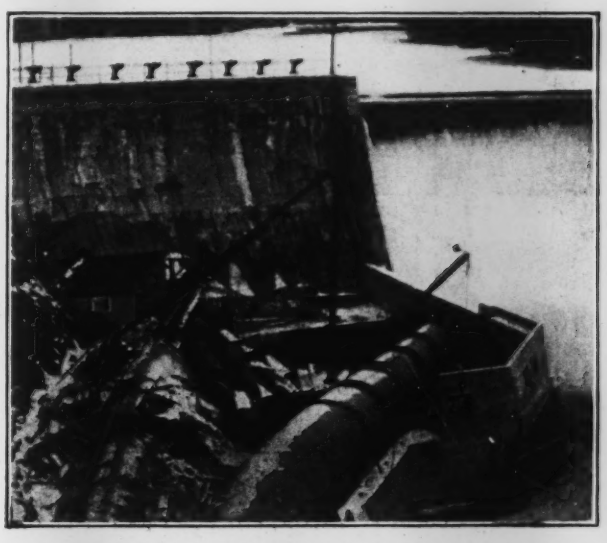
One of the novel features of the new installation is the method of connecting these six pipes to the new 12-ft. pipe line, at the same time continuing two of them in use as waste or sluice pipes. They are connected through sleeves, cast-iron specials and valves to a steel plate manifold which tapers from 5 to 12 ft. in diameter. The horizontal center line of the manifold is at the elevation of the two 5-ft. flanged pipes, or 9 ft. higher than the four 5-ft. sluice pipes. Inside of the four 60-in. sluice pipes are inserted 15-ft. sections of 58-in. outside diameter riveted steel pipes or sleeves, which are leaded and calked at the inner or upstream ends, the lower ends being flanged for connection to 60-in. cast-iron Ys and bends. The two waste pipes nearest the center of the stream will continue to be used as such. Two 60-in. cast-iron Ys with branches looking upward connect to the flanges of the inserted sleeves, the horizontal runs continuing through horizontal riveted steel waste pipes, passing under the main gate house, discharging into the stream and controlled by two 60-in. Chapman gate valves in the covered concrete chamber.

In the accompanying view, which shows the downstream face of the dam and the reconstruction work under way last fall, the condition of the dam at that time is shown. The tapering steel manifold and bend, the existing 7-ft. wood-stave pipe line, the old gate house and the new 5-ft. outlet pipes under construction are shown also. The two new 5-ft. waste pipes will pass through the diagonal wall at the right.

To the upward branches of these waste pipes are bolted 60-in. cast-iron eighth bends, effecting a rise of 9 ft. to the elevation of the manifold. For the other two waste pipes the rise of elevation is effected by two 60-in. cast-iron eighth bends, forming a reverse bend, attached to the insert or sleeve flanges. To the two flanged pipes 60-in. horizontal riveted steel pipes are attached, the lower ends of which are in line with and at the same elevation as the ends of the upper flanged cast-iron bends. To these six flanges the six 60-in. main gate valves are bolted. From the valves 60-in. riveted steel branches of varying length connect into the tapering manifold. These valves are covered by a concrete gate house which



SIX PIPES THROUGH DAM MEET IN ONE TWELVE-FOOT MAIN LINE TO POWER HOUSE



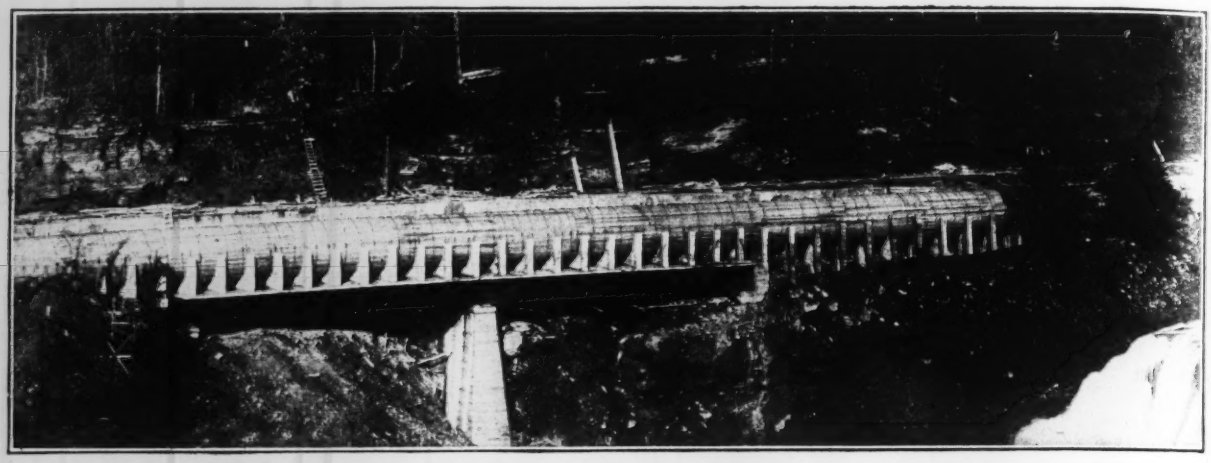
NEW TWELVE-FOOT PIPE REDUCED TO TAKE FOUR FIVE-FOOT PIPES THROUGH DAM

also contains a steam heating boiler. The old and the new gate houses will be connected.

The manifold terminates in a special steel sleeve or expansion joint for connection to the 12-ft. wood-stave pipe line. A manhole and 72-in. vertical steel vent pipe 55 ft. high are provided just above this point. The pipe line consists of about 2680 ft. of wood-stave pipe of Douglas fir and of about 800 ft. of 12-ft. riveted steel pipe, all running in a southerly direction and terminating on the banks of the gorge above the new power house. It follows the east or stream side of the old pipe line, which was backfilled and covered. The new pipe, however, will be left entirely uncovered. Wood pipe is used down to about 125 ft. static head, at which head the ¾-in. diameter steel bands are only 2 1/16 in. apart. Below this point steel was more economical than wood.

On account of the proximity of the two lines it became necessary to build a thin concrete wall close to the old wood pipe for a distance of about 1500 ft. below the dam, to maintain the cover and for protection from the effects of blasting alongside. For a distance of about 800 ft. below the dam a concrete wall was also required along the stream side for flood protection. The new wood pipe is supported on reinforced-concrete cradles on 7-ft. centers extending up to the horizontal center line of the pipe. After completion the annular space between the pipe and the cradles will be filled with cement grout. At a point about 1200 ft. southerly from the dam the new pipe line crosses a ravine on a bridge consisting of two plate-girder spans, respectively 72 ft. and 68 ft. 8 in. long, on the thin reinforced deck of which concrete cradles are constructed. One of the views shows the construction. At three points along the pipe line it became necessary to construct piers 10 to 20 ft. high underneath the cradles.

The 12-ft. steel pipe line is built with inside and outside rings with butt straps at longitudinal joints and stiffened at short intervals by circumferential angles. An expansion joint is provided at the junction with the wood pipe similar to that at the end of the manifold. This pipe is supported on concrete cradles and is left un-



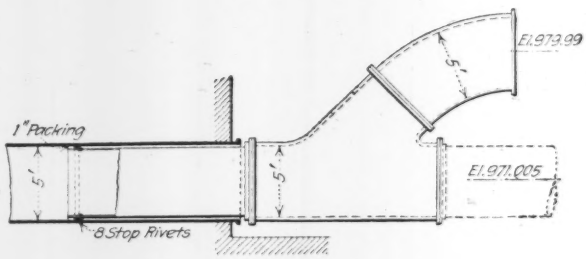
OVER A GULLY THE WOOD-STAVE PIPE ON ITS CRADLES IS CARRIED ON A PLATE-GIRDER BRIDGE

covered. About 200 ft. north of the end of the main pipe line is a steel hemispherical-bottom surge tank 40 ft. in diameter and 75 ft. high, with 12-ft. riser, the top of the tank being 177 ft. above the concrete piers. The riser and tank are protected by wooden housing and heated by steam. The foot tee and pipe for a short distance will be incased in concrete.

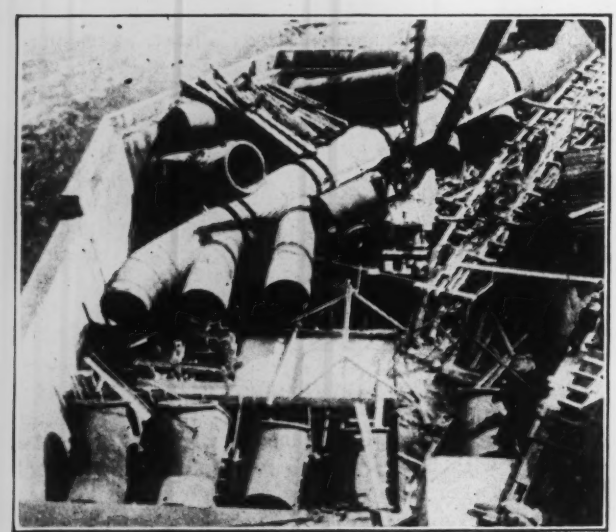
At the power house three 7-ft. penstocks branch from the main pipe line, the head at the power house being 106 ft. The three 9,000-hp. turbines, of which only two will be installed at present, are of the three-bearing Francis type, single wheels, vertical shaft, spiral case, 341 r.p.m. direct connected to 6400 kw. (8000 kva.), three-phase, 13,200 volt, 60-cycle Westinghouse generators, with direct connected exciters mounted above the thrust bearings. The turbines will be controlled by Lombard governors, which will also be direct-connected to synchronous pressure regulators. The draft tubes and pressure regulator discharge passages are molded in the concrete power house foundation, and the volutes incased in concrete up to the horizontal center line.

The 2200-volt current from the old station will be transformed by air-blast transformers up to 13,200 volts and conducted to the new buses. Current from the buses will pass out of the building to an outdoor transformer switching station, where it will be transformed to 44,000 volts and distributed to the three transmission lines to Utica and Rome.

Construction of the plant, which is now approaching completion, presented no particular problems, except for



JOINT CONVERTS OLD PIPE THROUGH DAM INTO MAIN CONNECTIONS ABOVE AND SLUICE OUTLET BELOW



DOWNSTREAM OF DAM—MANIFOLD PLACED TYING UP FIVE-FOOT PIPES WITH TWELVE-FOOT MAIN

the difficulty of housing labor and for delays caused by early rains and the very cold weather of last winter. A camp accommodated 200 laborers and the higher class labor and executives were housed in a nearby hotel taken over by the company. The concreting of the pipe line is described in a separate article in this issue (p. 1060) and some views of the sheathing of the power house for winter concreting will appear soon.

The plans for the Trenton Falls extension were made and the work was executed under the direction of Thomas E. Murray, consulting engineer, New York, with Philip Torchio, New York, in immediate charge of the electrical installation, and George A. Orrok, consulting engineer, also of New York, in charge of the balance of the work. The power house and electrical plans were made in Mr. Murray's office. The preliminary work and location were done by the writer, who also assisted in the preparation of the plans in general. The hydraulic installation, intake, manifold and much of the concrete work were designed in the company's office at Utica by C. Voetsch, hydraulic and electrical engineer.

The general contract for excavation, concrete work and structural work is being carried out by the U. S. Structural Co., Inc., Dayton, Ohio; the steel manifold by the Utica Steam Engine & Boiler works, Utica; the steel pipe line and surge tank by the Chicago Bridge & Iron Works, Chicago; the wood-stave pipe line by the Washington Pipe & Foundry Co., Tacoma, Wash.; the turbines and hydraulic equipment by the Platt Iron Works, Dayton, Ohio; the generators and exciters are furnished by the Westinghouse Electric & Manufacturing Co. and other electrical apparatus by the General Electric Company.

American Industry Must Prepare Now for After the War

Reconstruction Commission, to Be Appointed by President Without Delay, Is Suggested — Names Mentioned Include Heads of National Engineering Societies and Men Prominent in Various Industries

By Wingrove Bathon
Washington Representative, Engineering News-Record

PEACE will come some day.

In the meanwhile, American industry is doing nothing whatever in an organized way to prepare for the necessary readjustment.

On the other hand, England and her colonies, France, Italy, the Teutonic empires, the Far Eastern countries, and the Latin American countries have begun to prepare for readjustment and reconstruction.

What must we do?

This article, and others to follow, are written for the purpose of suggesting the immediate creation of an agency to deal with the situation which will confront American industry at the end of the war—to gather facts now, to make plans now, to educate men now, and to lead the industries of the country in the victories of peace when the right time comes.

In detail, this is to suggest that a great service would be done to the American people, and perhaps to all of the free peoples of the world, in view of the resources of the United States which must be drawn upon by the whole world for a long period after the war, if the President of the United States would appoint forthwith a commission, to be the President's own commission, to prepare for after-the-war problems; such a commission to be one not hampered by legislative enactments of Congress as to powers upon which it might be difficult for Congress to agree; not curbed and controlled by Government appropriations or the fear of lack of them; which nevertheless should certainly be established under the Government sanction of an executive order; and which should be assisted by an Advisory Council of Government officials, to be credited, and possibly by the chairmen of some committees of Congress. Many executive officials and legislators are too busy with the work of the war to lay aside their burdens of today and deal with after-the-war problems. Their assistants and associates should be used. As to the main commission, it should include not only leaders in industry of all forms, taken from the ranks of private endeavor, but it should include leaders of labor, leaders in education, and leaders in every other endeavor which enters into industrial effort. Such a commission should report only to the President, and should take as much of its inspiration from his leadership as he had time to spare from the conduct of the war with which he is charged by the Constitution. Such a commission might very well include the following men:

E. H. Gary, president of the American Iron and Steel Institute; Samuel Gompers, president of the American Federation of Labor; Arthur N. Talbot, president of the American Society of Civil Engineers; C. T. Main, president of the American Society of Mechanical Engineers; E. W. Rice, president of the American Institute of Electrical Engineers; Sidney J. Jennings, president of the American Institute of Mining Engineers; William H. Nicholls, president of the American Chemical Society, F. J. Tone, president of the American Electro-Chemical Society; J. B. Doan, president of the American Machine Tool Builders Association; H. A. Wheeler, president of the Chamber of Commerce of the United States; P. H. Gadsden, secretary of the American Electric Railway Association and resident Washington member of the Electric Railway War Board, and S. M. Williams, president of the Highway Industries Association, in addition to the presidents of some of the various national organizations occupied with production and manufacture in the lumber, leather, rubber, textile, glass and other great industries of the country; as well, perhaps, the master of the National Grange, Patrons of Husbandry, the president of a great railroad, the president of a great shipping company, the president of a great educational institution, the president of a great insurance institution, and perhaps the president of the American Bar Association and the president of the American Medical Association; but in any case, and by all means, even if only to assure reports from abroad, the following representatives of American business in other countries: A. V. Edwards, secretary of the American Commercial Club of Argentina, Buenos Aires; Charles E. Lydecker, secretary of the American Chamber of Commerce for Brazil, Rio de Janeiro; James R. Morse, secretary of the American Chamber of Commerce in China, Shanghai; George M. Cassatt, secretary of the American Chamber of Commerce in England, London; Charles H. Sherrill, secretary of the American Chamber of Commerce in Paris, France; J. B. Stetson, Jr., secretary of the American Chamber of Commerce for Italy, Milan; C. B. Parker, secretary of the American Chamber of Commerce for Mexico, Mexico City; Preston M. Smith, secretary of

the American Chamber of Commerce for Spain, Barcelona; and Theodore R. Yangco, secretary of the Chamber of Commerce of the Philippine Islands, Manila.

In Washington, the peace-time industries of the country are now being placed gradually upon a war basis. There has been time for a gradual "turning over" in the further organization of the war; this has been proceeding steadily month by month. But, when the industries of the country have been fully placed upon a war-time basis, when supplies of labor, sources of material, reserves of capital and the markets for production have all been altered to meet war needs, it will be impossible to place industry back upon a peace basis gradually without danger of disaster second only in importance perhaps to the actual loss of the war.

To meet that danger there must be organized preparation, such as is now proceeding in all of the countries at war except the United States, and these suggestions are made in order to set forth a working plan, as a nucleus for discussion and action.

Discuss, Act, Everywhere Save Here

The facts and the prospects for the future are being discussed and acted upon in almost every country of the world except this. Literally, thousands of books, pamphlets and other writings have been produced in foreign countries to educate the people along these lines. More than two years ago there was created in Great Britain a reconstruction committee, which has since become an agency of the British Government, the work now being in charge of Dr. Christopher Addison, a minister in the British Cabinet without portfolio, and more than two hundred subcommittees plentifully supplied with experts are now engaged in solving British after-the-war problems.

Details of what has been done in Great Britain and the other countries previously mentioned, some suggestions as to what should be done toward readjustment in this country, and suggestions for the personnel of an advisory council, also to be created by executive order, under the chairmanship, perhaps, of Frank Lyon Polk, counselor for the Department of State, and second in command of that department, will be offered in following articles. The personnel of a suggested advisory council will be dealt with in the next article, as of prime importance because this personnel will include many of the detailed legislative and executive war organization contacts of the United States, which must be continued at work long after the war in all likelihood—to use a homely phrase, to assist in "unscrambling the eggs."

There is need at once for a responsible high officer of the Government, occupying a position such as that of the Counselor for the State Department, and for him to have important associates on such an advisory council to answer fully, freely and day by day, now, the questions that a President's commission on readjustment and reconstruction might put to the Government, and to help solve the problems of such a commission.

Because of accelerated thinking, we can secure after the war the adoption of ideas that otherwise would not be acceptable, or would be acceptable only after a very lengthy educational process. Therefore we have an opportunity now; for, in addition to such obvious readjustment and reconstruction work as the orderly reintroduction to industry of returned soldiers, the development of export trade, and the use of our productive capacity for our industries expanded by war needs, we can use, now, the opportunity to secure the adoption by the people generally of economic theories such as the husbanding of our exhaustible natural resources—coal and other fuels, iron, timber, etc.—and we can also bring about now the adoption of policies which will insure the perpetual renewal of even the so-called inexhaustible natural resources, such as the soil and its products.

The tendency in any civilization, after the struggle to subdue new lands is passed and life becomes less harsh, is to seek ease and pleasure, and not to put forth such great energy in production. The result is that the demand tends to become greater than the supply; that is, to consume more than is produced. This leads to social dissatisfaction and the moral influences which tend to decay.

A readjustment and reconstruction commission must be set to work in this country at once.

How Emergency Buildings Should Be Protected Against Fire

National Fire Protection Association Adopts Specifications Suitable for Wood Frame Construction

AT THE recent annual meeting of the National Fire Protection Association recommendations were made for emergency housing and for improving the fire protection in existing cantonments and emergency buildings of wooden construction. The latter specifications are for the most part as follows:

Dividing Partiiions—Partitions which serve to subdivide cantonment buildings into two or more main areas should be made reasonably fire-resistive so as to aid in restricting a fire to the portion of the building in which it originates.

Such partitions should either be built entirely of incombustible material, or metal lath and plaster; or plaster board attached to both sides of wooden studding will serve fairly well where better construction is not feasible. If plaster board is used, it should not be less than ½ in. thick, and all joints should be cemented. A thin coat of plaster over the plaster board will greatly increase its efficiency. Metal lath and plaster will make a more dependable covering.

All such partitions should extend to the underside of the roof boards, and a tight joint should be made between them.

In buildings over one story high, the partitions should be adequately fire-stopped at the floor levels.

Such partitions should have no openings except doorways, all of which should be protected by ½-in. solid, flush, wood, self-closing doors. Cheap wooden panel doors would offer very little resistance to the passage of fire, and should never be depended upon for such service. Metal, or metal covered doors, would be very desirable where conditions are such as to justify the increased expense.

Stairways—Open interior stairways should not be

permitted. They should be fully inclosed with substantial fire-resistive partitions similar to those described for "Dividing Partitions." All stairways should open directly to the outside of the building. Any additional openings to the interior of the building should be protected by 1½-in. solid, flush, wooden, self-closing doors.

Each barrack building over one story high should have at least two stairways as remote from each other as possible. Several severe injuries have already occurred from occupants of two-story cantonment barracks being forced to jump from second-story windows because a fire had cut off the single stairway.

Connecting Corridors—Connecting corridors between buildings should be provided with substantial fire-resisting cut-off partitions extending at least 3 ft. through the roof, and down each side of the corridor. Solid, flush, wooden doors should be provided for the passageway. Such cut-offs would prevent the rapid spread of fire from one building to another through the corridor, and give the fire-fighting force a chance to control it.

Inclosed Courts—In some instances, buildings have been erected around inclosed courts with no direct outlet; these should be provided with openings affording access and exit to opposite sides of the courts.

Protection of Ventilators—All ventilator openings should be screened to prevent entrance of sparks.

Preservation of Fire Breaks—It is important that all spaces between buildings, particularly those intended for fire breaks, be kept free and clear of all combustible material and additional buildings. There has been a strong tendency in some emergency camps to utilize such spaces for storage of combustible supplies, or refuse, and there has apparently been an irresistible temptation to erect other buildings in these vacant spaces. Such practice should be prohibited.

The storage of combustible material, such as hay, wood, barrels, etc., in large quantities in open spaces, even considerably remote from the camp, should be discouraged. The chances of controlling a fire in such material, and consequent reduction in loss, are greatly increased by subdividing the material in storage lots of moderate size.

Fire-Fighting Equipment—Fire-fighting equipment of every kind should be regularly inspected, and should be rigidly maintained in perfect working order.

Few Frozen Mains at Camp Grant

Water mains at Camp Grant, Rockford, Ill., suffered little from frost last winter, principally because of the thick layer of snow. The mains are laid 5 to 6 ft. below ground level; no trouble was encountered until spring, and then the only pipes frozen were of 2-in. diameter and smaller. These were thawed out quickly with an electrical apparatus.

Surprisingly few cases of broken mains have occurred, and these cause no serious trouble, for the section in which a break occurs can be cut out, the mains being laid in a system of interlocking loops, as described in *Engineering News-Record* of Aug. 30, 1917, p. 388. In consequence, only the barracks adjacent to the break are inconvenienced.

First Lieut. C. W. Older, Q.M.C., N.A., is the officer in charge of water-works and plumbing.

State Law Limits Castleton Bridge to Single Span

Act Prohibits Center Pier—War Department Approved Two-Span Design—Four Million Dollars Excess Cost Involved

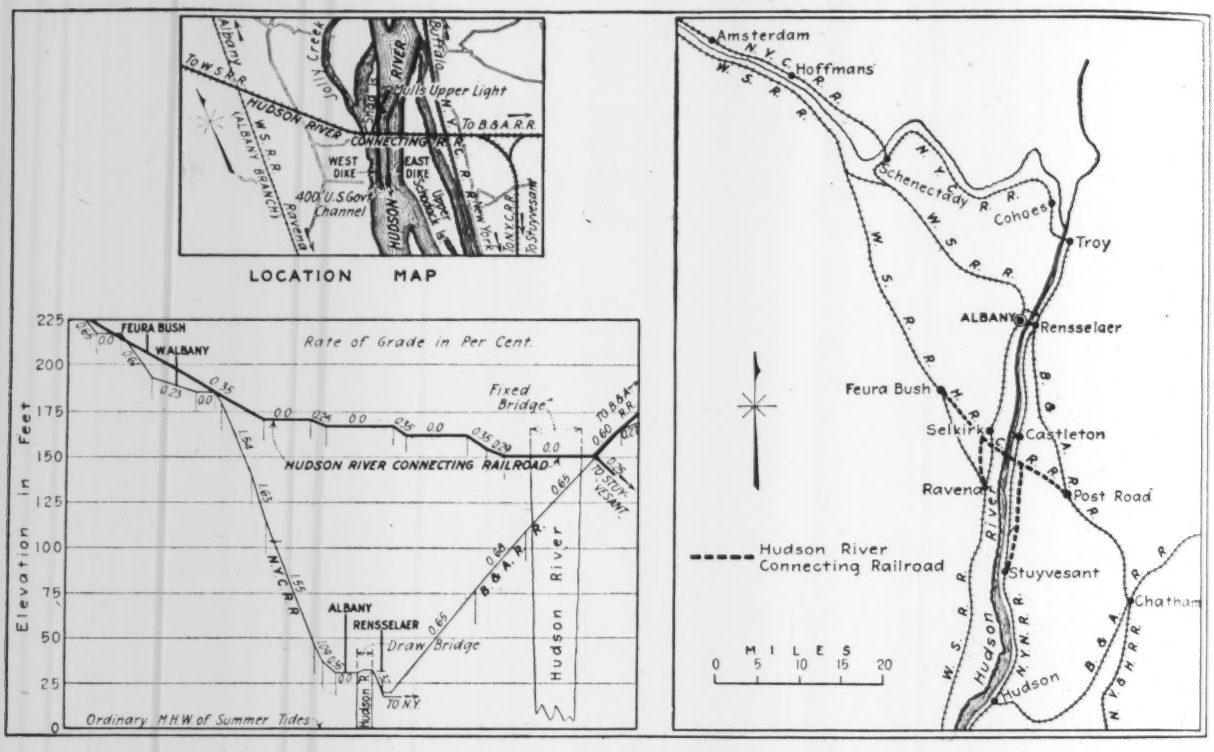
JURISDICTION over bridges crossing navigable streams has been assumed by New York State through a recent act of the legislature aiming to control the construction of a proposed bridge over the Hudson River at Castleton. The War Department had previously approved the design prepared for the bridge, in accordance with the Federal law vesting in the War Department the exclusive control over bridges crossing navigable streams. As the new State law vitiates this approval, the question of State or Federal jurisdiction is at once raised.

The Castleton bridge is part of an important cut-off line projected by the New York Central R.R. which would furnish an urgently needed improvement in transportation from the Great Lakes to New York and Boston. As the map shows, the line bypasses the Albany district. Because the trackage available in this district is limited, the new line would enable the transportation of freight to gain several days, and would materially increase the traffic capacity of the New York Central system. It would eliminate about 300 ft. of rise and fall and release from pusher service ten switch engines, which are now required for trains westbound out of Albany.

Figures bearing on the questions of bridge design involved in the case, obtained from H. T. Welty, engineer of structures, New York Central R.R., show that the new State law would require an excess expenditure of about $4,000,000 for the bridge. At a hearing before the Governor, however, supporters of the law asserted that the excess cost need not be greater than $1,000,000. In connection with this claim they presented a rough sketch of a steel arch spanning 1000 ft. A sketch of a cantilever span with low masonry piers was also submitted. Neither the arch nor the cantilever, however, maintained the required vertical clearance for the full width between dikes.

It was argued for the law that future navigation interests will require a channel equal to the full width between Government dikes. This argument is based on the expectation that ocean traffic will in the future go up the Hudson River to Albany. The present Government channel width north of Hudson is 400 ft., at the maximum, with a dredged depth of 12 ft. Studies made by the War Department indicated that the 600-ft. span of the approved design would not impede vessels even if the Hudson River is improved for ocean steamship traffic terminating at Albany, with a depth of channel of 27 ft. The Central New England R.R. bridge at Poughkeepsie, fifty miles below Castleton, has a center span of 540 feet.

The law amends the general railroad law by inserting the provision that the State Engineer and the State Superintendent of Public Works must approve the plans for any proposed railroad bridge "across the Hudson river, or any approaches thereto, at any place or point between the Federal dam at the city of Troy and the



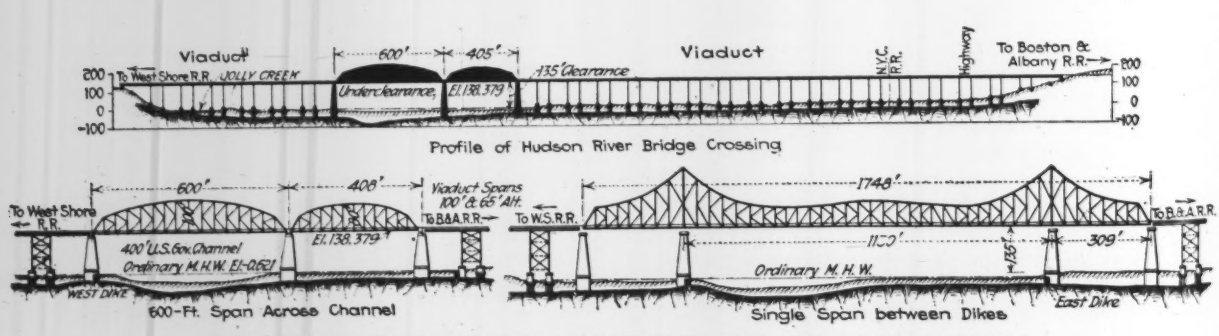
CASTLETON CUT-OFF PROJECTED TO CARRY TRAFFIC AROUND CONGESTED ALBANY DISTRICT

most southerly point therefrom where both opposite banks are wholly within the state of New York." These officials are forbidden to approve a design providing for "more than a single span across the Hudson River between the present dike lines or for any pier or abutment between the present dike lines of the river, or for a clearance of less than 135 ft." above mean river level. While general in its terms, the law was drawn with direct reference to the Castleton bridge. Government dikes or training walls do not exist in the Hudson outside of a short section of the river.

The design approved by the War Department provides two simple truss spans of 600 and 408 ft. flanked by a west approach viaduct about 1200 ft. long and an east approach viaduct about 3000 ft. long. This design is shown in the upper sketch of the accompanying drawing. The lower sketch shows the structure that would be required under the new state law. Both designs have been worked out by trial and adjustment of the spans and proportions to secure maximum efficiency.

In the cantilever design, the position and spacing of the main piers are fixed by the dike lines, but the position of the anchor piers permits of adjustment. The anchor-span length of 309 ft. shown is to be regarded as tentative, based on comparative estimates for several span lengths but subject to change if further study should show another length to afford increased economy. show another length to afford increased economy.

The basis of proportioning in both cases was E65 loading for the trusses, and E70 loading for the floor. The bridge is to carry two tracks. Open-tie floor construction is to be used in the truss spans, and ballasted concrete slab decking on the viaduct. The use of fender girders is contemplated, to make the bridge fully as safe against accidents caused by derailment as the ordinary short-span girder structure. Horizontal skid girders attached to the trusses, as used on the Beaver bridge of the Pittsburgh & Lake Erie R.R., are planned for the simple spans. In a cantilever span the fender system would probably take the form of through longi-



LONG-SPAN DESIGN FOR CASTLETON BRIDGE INCREASES COST BY $4,000,000

tudinal girders in the floor system, similar to those used in the Forth and Quebec bridges.

In the simple-span design the two river spans weigh 8200 tons, while in the cantilever structure the 1748-ft. length between anchor piers weighs 29,000 tons. The calculated weights were compared with the weights of several existing bridges of similar type and capacity, and were found to agree closely.

The calculations were based on the use of structural steel; it is believed that estimates for special high-strength steel would not change greatly the ratio of weights. However, in comparing the figures, allowance must be made for the difference in length of the approach viaduct. The estimates for the viaduct are 14,800 tons for the simple-span design, and 12,300 tons for the cantilever design, using in both cases a steel structure as shown in the drawing, with 65-ft. tower spans and 100-ft. intermediate spans.

The total steel weights for the two bridges, then, are 23,000 and 41,300 tons. Thus, the single-span cantilever design demanded by the New York State legislature requires 18,300 tons more steel than the other. The cost would be about $3,900,000 greater, on the basis of unit costs of six to eight cents per pound for the steelwork erected. The viaduct was estimated at the lower figure and the cantilever structure at the higher, the simple spans being intermediate. The cost of the falsework required to erect the simple span, and that of the anchor spans of the cantilever design, were estimated separately.

The approach viaduct, for which a steel trestle design is shown, has been the subject of detailed study. Two principal alternative designs were considered, concrete arches of about 175 ft. span and 350-ft. steel arches. The latter proved uneconomical, while the concrete arch design was found to have points of advantage. Prices have varied so greatly in the past two years that estimates of comparative costs are not reliable for any great length of time.

The foundation conditions are fully constant over the entire width of the crossing. Good foundation rock is encountered about 50 ft. below mean tide at the west end and about 40 ft. at the east end. For the main piers pneumatic caissons were contemplated; for the viaduct pedestals, piles or cylinders dredged down to the rock.

The plans as shown were worked out by the engineering department of the New York Central R.R. for the Hudson River Connecting Railroad Corporation, its subsidiary. George W. Kittredge is chief engineer.

Study of Mechanical Hysteresis Will Advance Our Knowledge of Materials

Failure Under Repeated Stress Apparently Related to Loss of Energy in Stress—Cycle of Loading and Unloading—Some Effects of Hysteresis Analogous to Those of Backlash and Dashpot Action

By Frederick J. Schlink
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Apart from the investigations of the metallurgist, studies of the mechanical quality of materials very largely take the form of determinations of elastic limit, ultimate strength, deformations at yield point and at rupture, and similar properties directly determinable from a single series of readings upon the specimen tested. Observations of this character, it would seem, cannot greatly further our knowledge of the action of materials under stress. In certain studies underlying the design of measuring instruments the writer has been impressed by the important role which the property of mechanical hysteresis plays. The relation of this property to the endurance and tenacity of materials has been discussed only in a way that is limited and far from exhaustive.

The investigation of hysteresis in the metals has been handicapped by the want of measuring instruments that are sensitive enough to determine the extremely small strain differences involved. On this account, most of the determinations made have been in connection with wires and rods in torsion. Recently J. J. Guest and F. C. Lea have published an important paper on this subject (*Proceedings* of the Royal Society, June, 1917) in which the existence of hysteresis (torsional), even at low stresses, is clearly demonstrated and defined. Important conclusions are drawn relating to the effects of low-temperature heat treatment in removing the initial stresses which contribute to the hysteresis phenomenon, and to the absence of elastic after-effect at loads so low as not to overstrain any portion of the specimen. To be sure, now that the concept of the elastic limit has been demolished, we are somewhat at a loss to define "overstrain."

Hysteresis Defined As the Lag of Strain Behind Stress in Cyclic Loading

Hysteresis may be defined by reference to the load-deformation curve of a specimen carried through a cycle of loading and unloading. The material fails to follow the same rate of deformation in relation to load during the period of release of stress as during the period of its application. As a result of this difference between the behavior of the specimen with the load increasing and that with the load decreasing, the lines of the load-extension graph corresponding to these two processes are not coincident. This displacement between the increasing-load and decreasing-load lines of the graph, when exhibited through a complete and closed cycle of loading and unloading, gives rise to a loop known as the hysteresis loop.

The area of this loop represents the loss of energy due to imperfect elasticity; that is, the portion of the energy supplied to the specimen during the cycle which is not recoverable when the stress is returned to its initial status. It seems obvious that this absorbed energy is somehow related to the so-called fatigue

failure of structural materials under repeated stress application. This energy is largely expended in breaking down the structure and tenacity of the stressed body.

To give concreteness to this consideration, let us consider the case of a body in which the component elements may be looked upon as of finite dimensions; for example, a specimen of cloth. When a tensile load is applied to this material it is certain that before all of the longitudinal yarns can take up the stress, a phase of mutual adjustment of the yarns and their component fibers must take place. Some will be slack while others will be taut, some will be in close adherence to their neighbors while others will have comparative independence of action in the initial unstressed condition. When the load is applied the slack fibers and yarns take up a portion of the load, after the first stretching of those that are taut, while those which adhere to adjacent ones will slip relatively to their neighbors in amounts dependent upon their orientation, their moduli of elasticity and their initial tautness. As the load increases, these adjustments within the fabric decrease until incipient failure sets in.

If, before the last named state is reached, the load is removed, the specimen will return to a condition of zero stress, but its extension will not return to zero, as some of the displacements which have taken place during the earlier stages of stress application are not reversible, being maintained at more or less definite values by the friction which exists between the contiguous elements. If a second cycle of loading take place, many of these adjustments will not recur, since the fibers have been permanently disposed into positions most favorable to uniform distribution of the stress. A fairly definite proportion of them, however, will recur, comprising mainly those which, due to insufficiency of friction between elements, have been allowed to approximate their initial condition of slackness or mutual contact. Thus, at every repetiton of the loading and unloading cycle certain slips and shifts will take place in the fabric, decreasing, however, in number and extent with each succeeding repetition.

It is this condition which must largely account for the ultimate failure of the fabric under repeated loadings, since the energy involved in these slips and shifts of the fibers and yarns is largely expended in mechanical wear of the material itself, diminishing the effective cross-sections and breaking down the adhesions and interlockings which exist between the component fibers of the yarn and between the component yarns of the fabric.

Possible Relation Between Hysteresis and Endurance

It is believed that something of the same sort goes on in the more usual structural materials, such as metals, masonry, leather, etc. We know that even in the metals a discernible slipping of crystal surfaces actually does occur under repetition of stress. Is it not quite likely that the form and magnitude of the hysteresis loop will afford an index of the endurance of the material under repeated load, an index in fact far superior to that obtained through the expensive and protracted endurance tests?

Helical springs, as is well known, have superior properties as regards endurance under repeated loading compared with flat springs working under ostensibly equivalent unit stresses. May this not be due to a greater uniformity in the stress condition which obtains in the helical spring within a given bundle of contiguous elements, in contradistinction to the relative slipping and interstrain between contiguous elements in the flat spring which, as the beam theory shows, functions under stress conditions varying in every cross-section, both longitudinally and transversely? Expressed in somewhat different form, may not the difference between favorable and unfavorable properties of a given structural form as regards endurance under repeated stresses be expressed as a function of the *gradients* of stresses across its sections?

In the large field of measuring instruments, the role of hysteresis is a vital one, being evidenced by differences in successive instrumental readings under identical conditions as regards the quantity being measured and the other circumstances associated with the observation. For example, in an aneroid barometer, the reading at a given atmospheric pressure will differ accordingly as the pressure has been increasing or decreasing. Two causes contribute to this: the first, backlash in the mechanism, and the second, hysteresis, principally in the force-measuring elements of the aneroid—the diaphragm and the spring.

The amount of this hysteresis is subject to variation from several causes, as the magnitude of the stresses obtaining in the diaphragm at the particular atmospheric pressure, and the temperature at which observations are taken. Here, then, we have an instrumental error of a sort not to be voided by the application of corrections, and on that account of the most adverse character. This error is common in such instruments as the Bourdon pressure gage, in which it is increased by the common practice of using brass for the Bourdon tube, this alloy having relatively unfavorable properties for measuring purposes, in the sense that its mechanical hysteresis is high.

Hysteresis a Source of Error in Measuring Instruments

Either hysteresis or its mechanical analogue, backlash, is present with startling regularity in every measuring instrument. Even in an automatic scale, where the parts may all be subject to low working stresses and may be constructed with the utmost care and nicety of fit, the scale readings exhibit the characteristic divergence between the increasing load and decreasing load branches of the correction curve, strikingly similar to the hysteresis loop met with in the stress examination of a material. If the scale is not of the elastic-resistor type, of which the spring scale is an example, the hysteresis loop must arise almost exclusively from non-reverting shifts and the like in the linkages. That this is the case is clearly shown in such a scale by the settling back to the initial condition which occurs when the parts of the scale are sharply jarred under load.

The effects of backlash in producing this loop have been carefully examined by the author, and, instead of being of the irregular and unaccountable type which they have commonly been supposed to be, they are shown

by analysis to produce divergences in the readings of the instrument exactly analogous to the hysteresis curve for the loading and unloading of a structural material. It will not be worth while to digress at this time for detailed demonstration of these facts, but it may be said that almost every characteristic of the hysteresis phenomenon for a stressed structural material is duplicated in a mechanism containing backlash, in that the width of the loop is distinctly a function of the range of motion or reading over which the instrument has been operated—corresponding to the range of stress, which affects the width of the hysteresis loop in a stressed structural specimen—and in that the size of the loop increases with poor fitting of the parts and with excessive clearance and frictional resistances generally, as it does in the case of a structural specimen which is not homogeneous or continuous and in which we may expect to find elasticity notably imperfect.

Many Relations of the Question Need To Be Investigated

The absolute regularity with which this phenomenon of hysteresis occurs in measuring instruments of every sort, and the similarity of its occurrence in the case of structural members brings strongly to consideration the need of acquiring a better knowledge of the subject. Both kinds of irreversibility are "backlash"; the one in finite dimensions and the other in infinitesimal ones. Both are characterized by slips and shifts of the component parts of the structure or mechanism. In the one case perceptible mechanical wear occurs; in the other more or less gradual destruction of the tenacity properties or of the shape or dimensions of the specimen.

In order to make more evident the broad relation of this question to mechanical problems, let us consider one or two simple applications. The so-called fiber reproducer needles, often used on graphophones, are distinguished for the softness of their tone. Consideration shows, however, that there is not only a softening of the tone but a loss of some of the tone components, since, if the needle were perfectly elastic, practically all of the energy represented by the undulations in the record disk would ultimately reach the reproducer diaphragm and there be transformed into audible sound. This is not the case. The fiber needle does not transmit all of the energy which it receives from the record groove, but damps out much of it, owing to the imperfect elasticity of the fiber. This not only reduces the volume but also modifies the complexity of the tone and impairs the accuracy of reproduction. At the same time that such a needle reduces the scratching noises originating at the needle tip, it also eliminates certain desirable elements of the tone, namely, the high-frequency overtones. This is the result of hysteresis in the material of the needle.

Aëroplane Shock Absorbers Should Have High Hysteresis

Recently certain samples of felt were to be examined with regard to their suitability for use in shock-absorbing parts of aëroplanes. At once the question was raised as to how the properties of the material which would make it suitable for this purpose could be defined. Were the material perfectly elastic, the only way in which it could diminish the effects of a severe blow would be in transforming a shock or vibration of low frequency into numerous vibrations of high frequency, the effect of which would be less destructive to life or material.

This is, in fact, the principle upon which automobile shock absorbers of the most common type operate, in that springs of high flexibility are so coupled with the springs supporting the body of the car as to dissipate in vibrations of higher frequency the large displacements of the regular springs. On the other hand, were the material in question perfectly inelastic (or plastic), it could only perform its function once, since its first use would deform it to a condition in which it would act as a mere transmitting medium incapable of absorbing further contributions of energy.

Dashpot Action in Shock Absorption Is a Desirable Quality

After these considerations, we may ask what are the desirable properties of a felt material to be used as shock absorbent. It should have hysteresis of a large enough order to absorb rather than to transmit much of the energy of a blow, but it must have elasticity enough so that it will not fall short by too great an amount of returning to its initial bulk after being subjected to such a blow. Moreover—and this is a distinct and perhaps equally important phase of the question—the felt may absorb energy at once by its deformation, giving it out again only after the lapse of a more or less protracted interval of time: this is the time factor in elasticity.

This is analogous to a second type of automobile shock absorber—that in which a dashpot is used, in which the stiffness in one direction is slight and practically independent of time, while in the other direction, though the stiffness may be similarly small in amount, it is governed by the restriction that the rate at which energy is restored is limited, to the end that the mechanism return to its original position only after the lapse of a considerable time. A common form of dashpot, in which the piston carries valves opening in one direction only, is an example of such an arrangement for shock absorption. It is analogous to a structural member having small hysteresis but extremely large time lag in its deformation for a particular sense of load application.

The question of time lag, commonly known as elastic after effect, is closely associated with the study of hysteresis. This is exemplified by the fact that in the less elastic materials, such as rubber, which is much used as a shock absorber in bumpers and the like, the hysteresis loop is subject to variation in its area and form, dependent upon the rate at which stress is applied and the time elapsing between alternations of stress. Neither property can rightly be investigated without reference to the other.

The author ventures the opinion that in this field much of striking interest and value to the engineer can be developed by moderate expenditure in research. It seems reasonable even to suppose that the most important results to be gained in the field of materials research are to be sought in this direction.

Trucks on Concrete Roadways Distribute Supplies at Railway Shops

Santa Fe Railway Handles Stores at Topeka Shops by Tractors and Trailers—Traction Tests Made with Small Trucks on Several Types of Surface Show Lowest Drawbar Pull on Concrete

By Con. M. Buck
Division Engineer, Atchison, Topeka & Santa Fe Railway, Topeka, Kan.

Concrete roadways to facilitate the trucking and hauling of storehouse supplies between storehouses, shops and freight cars are being built by the Atchison, Topeka & Santa Fe Ry. at its extensive shops at Topeka, Kan. About 2½ miles of these roadways, from 8 to 12 ft. wide, are now under construction, and already the use of large and small motor trucks and trailers on them has shown a great saving as compared with horse-drawn wagons, push cars and hand trucks. Several types of pavement for the roadways were tested, and concrete showed the lowest drawbar pull.

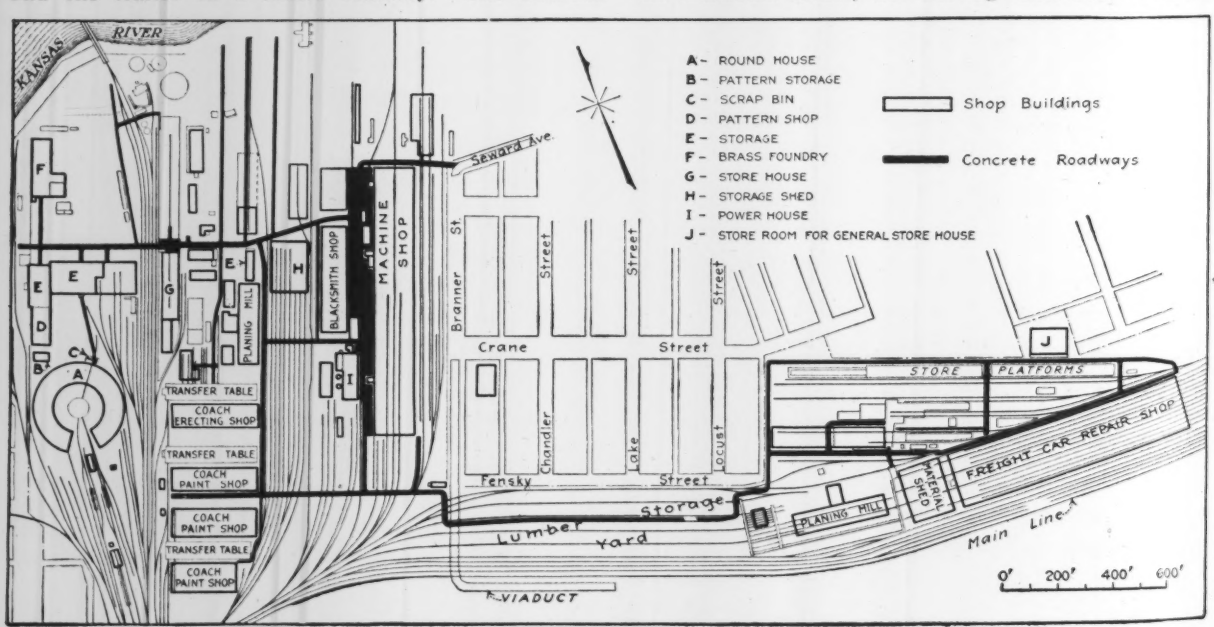
A study of the hauling and trucking conditions was made, and it was found that the greatest economy to the company would result from the building of a system of concrete roadways. This study included a series of tests covering the performance of an electric truck loaded and light, with and without loaded trailers, and moving over roadways of earth, oiled cinders, wood, iron and concrete. Electric industrial or shop trucks used at Topeka are of 40,000 lb. capacity, weighing 2220 lb., and having rubber-tired wheels 15½ in. in diameter, with 3-in. tread. The trailers weigh about 400 lb. each. They have 8½-in. front wheels with 2½-in. tread, and 18-in. rear wheels with 3½-in. tread.

It was found that with a truck and trailers each carrying 2000-lb. loads, the truck could pull four trailers on a concrete roadway with less power at the motor and less drawbar pull than it took to move the truck and one trailer on a cinder roadway. The drawbar pull per trailer in starting the load was 90 lb. on concrete, 95 lb. on metal, 125 lb. on brick, 165 lb. on wood and 475 lb. on the cinder roadway. To keep the load moving it took a steady pull of 30 to 35 lb. for one loaded trailer on smooth trowel-finished concrete, 47 lb. on rough-surfaced concrete, 57 lb. on brick paving and 225 to 250 lb. on cinder roadway.

Concrete paving was selected on the basis of its favorable results in these tests. Plans and estimates were prepared, and authority was received for the construction of 10,706 sq.yd. of 12-ft. roadway and 3490 sq.yd. of roadway of smaller widths, together with 89 crossings of main and switch tracks in the yards. To this has been added 7625 sq.yd. of paving between the machine shop, blacksmith shop and power house which was originally authorized for brick paving.

Company forces are employed in the construction of these roadways. All side forms are of wood, set to line and grade as established by the engineering party. Any surplus dirt is then thrown out and the subgrade is dressed carefully to the level of the bottom of the 2 x 6-in. planks used for these forms. As most of the roads are located where cinder roadways now exist, they have good firm subgrade which requires no tamping. Where possible the excavated dirt is used against the shoulder and the excess is then carried away.

One-course concrete 6 in. thick is used for the roadways. The cement conforms to the specifications of the American Society for Testing Materials. The fine



LAYOUT OF CONCRETE ROADWAYS FOR TRUCKING STOREHOUSE SUPPLIES AT THE TOPEKA SHOPS OF THE ATCHISON, TOPEKA & SANTA FE RY.

aggregate is clean sharp Kaw River sand, taken from the river at Topeka and delivered at the work in cars. The coarse aggregate consists of clean crusher-run Garnett crushed stone, 1½ in. maximum size, from which all fine screenings have been removed. This stone is also delivered in cars.

The concrete is proportioned 1:2:4, and is mixed in a gasoline-driven batch mixer of 10-ft. capacity. Each batch is made with one sack of cement, 2 cu.ft. of sand, 4 cu.ft. of crushed stone, and 6 gal. of water, and is mixed for 1½ min. The steel reinforcement consists of one ¾-in. square corrugated bar along each edge of a 12-ft. roadway, this being staked to hold it in the center of thickness of the slab. For transverse reinforcement there is a 26-in. width of woven-wire fencing placed on each side of each expansion joint.

Expansion joints are spaced 30 ft. apart, and are composed of two thicknesses of tar paper held in place by a steel plate 6 x ¼ in., which is pulled out as soon as concrete has been placed to a point 10 ft. in advance of the joint. Some of this work is being laid without expansion joints, and we figure that it will be no more expensive to maintain the self-made joints or cracks than the regular joints. For roadways less than 12 ft. in width it was thought unnecessary to use the side reinforcing bars, but they are reinforced at the joints.

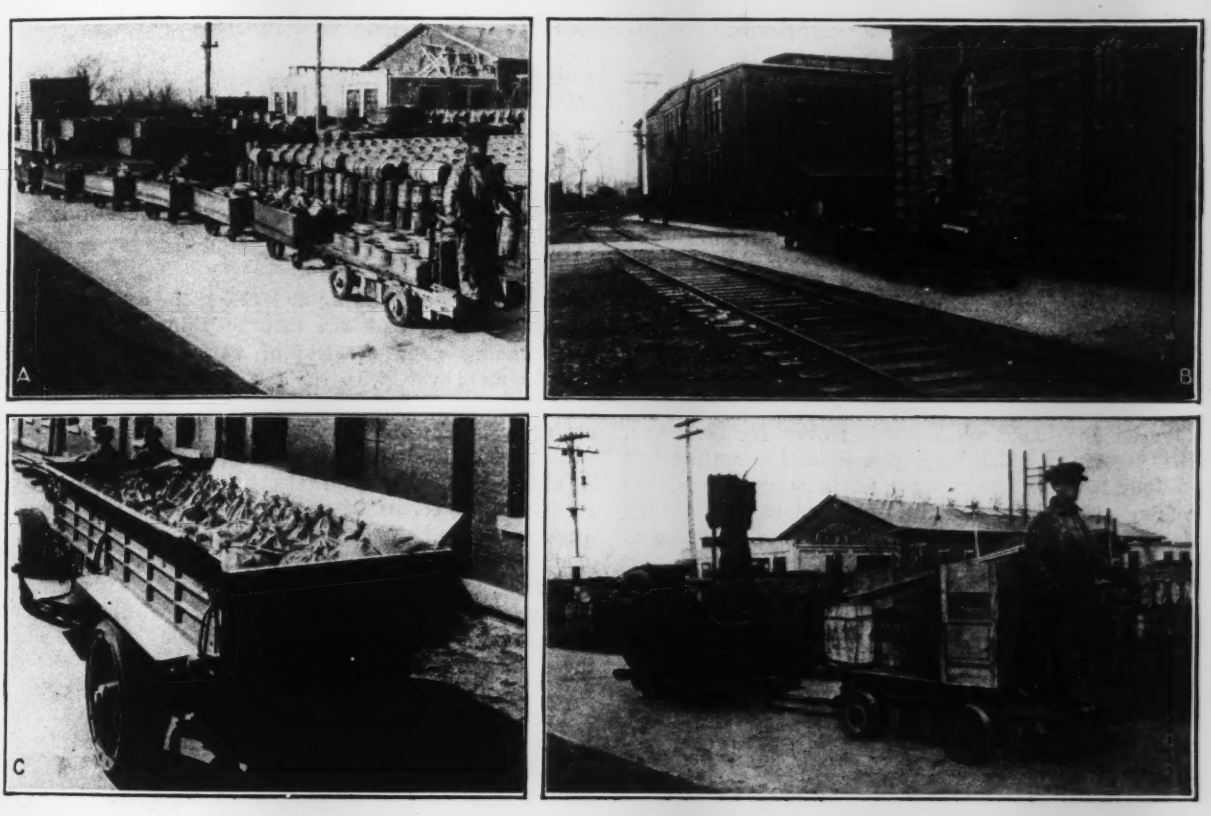
Where roadways entering at the side are of materials other than concrete, an angle iron 2 x 2 x ⅜ in. is anchored on the edge of the concrete roadway to protect the top corner from being broken away by the traffic.

The mixer delivers the concrete through its discharge chute into position in the roadway, where it is evenly spread and struck to surface with a template which gives a ½-in. crown to the surface. At the proper time-distance behind the concreting gang works the finisher, who after floating the surface with a wooden float gives it a brush finish.

As soon as the surface has taken a set, the area is covered with dirt and kept moist for one week, no traffic being allowed to pass over the roadway until after 28 days. At the end of this curing period the dirt is washed from the surface by the use of a fire hose. The dirt shoulders are then dressed, and the road is placed in service.

We are also using a long-handled 8-in. roller, 6 ft. long, made of ⅛-in. steel, to compact the concrete and roll out the excess water. After this we drag the surface with a rubber hose and then float it with a wooden float and give it a brush finish as mentioned above. The roller seems to give good results in making the concrete more dense and hastening the setting.

Where the roadway crosses the main line the crossings are constructed with concrete 12 in. deep beneath the ties and filled to the top of the ties. Upon this are placed a sand cushion and brick paving. The flangeways are made by angle irons 3½ x 3½ x ⅜ in., the horizontal bottom leg of the angle resting on concrete blocking with its outer edge against the web of the rail. The angle is fastened to the ties by bolts



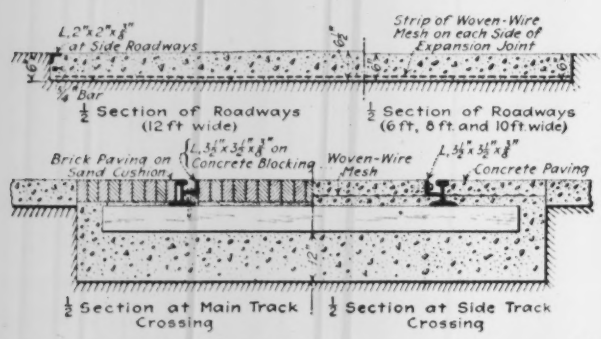
A—ELECTRIC TRUCK AND TRAILERS WITH 17,500 LB. OF BRASS CASTINGS. B—RECONSTRUCTED MOTOR HAULING FOUR TRAILERS WITH CASTINGS. C—MOTOR TRUCK WITH 64 SACKS OF CEMENT. D—SMALL ELECTRIC TRUCK WITH LIGHT LOAD HAULING HEAVILY LOADED TRAILER

A—ENGINEER CORPS SETTING OUT SIDE FORMS FOR CONCRETE ROADWAYS—NOTE STEEL REINFORCING ROD FOR EACH SIDE OF SLAB AND ANGLE IRON TO PROTECT EDGE OF SLAB AT CROSSROAD
B—TURN OF THE ROAD; 12-FT. ROADWAY PASSING THE DRY KILN

driven through holes drilled in the horizontal leg, and the paving is laid against the vertical leg.

The width of the flangeway is 1½ in., the small wheels on the electric truck making it desirable to have as small a flangeway as possible in order to avoid jar to trucks and loads when passing over the crossings. Brick crossings which were placed on the main truck and four parallel tracks were not a success from the trucking standpoint, and it is planned to take up the brick and lay concrete in these tracks also, in order to make smooth crossings for trucking.

For the sidetrack crossings, the construction is wholly of concrete, including the paving. Concrete is placed 12 in. deep under the ties and filled between them. Then the angle irons for the flangeways are placed and anchored, and 26-in. woven-wire reinforcement is placed between the flangeway angles and also outside the rails to the ends of the ties. Concrete is then filled in and surfaced level with the tops of the rails.


L, 2"x2"x⅜" at Side Roadways
Strip of Woven-Wire Mesh on each Side of Expansion Joint
¾" Bar
½ Section of Roadways (12 ft wide)
½ Section of Roadways (6 ft, 8 ft and 10 ft wide)
Brick Paving on Sand Cushion
L, 3½"x3½"x⅜" on Concrete Blocking
Woven-Wire Mesh
L, 3½"x3½"x⅜"
Concrete Paving
½ Section at Main Track Crossing
½ Section at Side Track Crossing

CROSS-SECTIONS OF TRUCKING ROADWAYS AND TRACK CROSSINGS AT RAILWAY SHOPS

The gang for mixing and placing the concrete is composed of a foreman, two shovelers in the stone car, one shoveler in the sand car, five men wheeling crushed stone, three men wheeling sand, one man wheeling cement, one engineman, one chute man placing the concrete, two men striking or leveling the concrete with a straight edge, and one man finishing the surface. The grading gang consists of an assistant foreman and six men, who, with the assistance of the finisher, set all forms and reinforcement. Line and grade stakes are given by the engineering party.

Great saving in time and money, as has been stated, is effected by the small electric trucks on concrete roadways, as compared with hand trucks and horse-drawn wagons. Trailers can be loaded in foundry, shops and material sheds, and taken direct to storage or placed in the box car for unloading. This makes only one loading and unloading of materials, while with wagons this work involved three loadings and three unloadings. Two White trucks have released two freight cars per day for use in revenue business.

The small trucks on the concrete roadways have been so successful that all push-car tracks are to be replaced with 8-ft. concrete roadways. These tracks cost $1 per ft. in place, and as an 8-ft. concrete roadway also costs $1 per ft., the investment is the same. The push-car tracks can therefore be taken up and replaced as an operating proposition, without an addition and betterment charge.

That portion of the work which is in service is highly satisfactory, and the character of the traffic passing over the roads can be seen in the views, which show electric trucks with trailers and also gasoline trucks. Nine electric trucks, with two large White trucks and two rebuilt Fords are now in service, and the horse-drawn wagons will gradually be supplanted, as more trucks and tractors are being ordered. These roadways will also carry the fire trucks.

The construction is being carried on by company forces under the supervision of W. C. Hunt, traveling storekeeper, to whom much of the credit is due for the study leading up to the adoption of concrete and for the careful execution of the work. H. Allison is foreman. The engineering field work is in charge of F. T. Morse, transitman. The work was designed by the writer.

Rational Basis for Determining Working Capital

Analysis of Maximum Lag of Collections Behind Disbursements of Large Gas Company Equally Applicable to Other Utilities

By Gaskell S. Jacobs

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IN THE appraisal of utility properties for rate purposes the element of working capital, although of relatively minor importance compared with the physical valuation of tangible capital, has not in the past been given the thought and analysis necessary to establish definitely the figure to be used in any specific instance. Arbitrary methods of estimating have been largely employed. For example, one month's gross revenue, two months' operating expense, the difference between current assets and current liabilities, have all been taken as a measure of working cash capital. None of these, in the mind of the writer, is better than a guess, and all are too general in their application. The amount of cash working capital required by a utility in the conduct of its business is largely a function of the manner in which its revenues are collected and its disbursements made. With a view toward establishing a definite method of fixing working-cash capital the following analysis was made as part of a valuation of a large Western oil gas utility and closely follows the actual conditions existing in the conduct of the utility's business.

What Working Capital Covers

Working capital is generally understood to cover materials and supplies on hand, including sufficient fuel for an extended period of operation, and in addition a sufficient cash balance for the ordinary operations of the utility. The material and supplies included in working capital should, for the purposes of a rate determination, embrace only such as are assignable to current operation, and not the large bulk of materials held awaiting future construction purposes. Likewise the available cash capital is held partly for construction activities. It is generally assumed that the funds for construction purposes, obtained from the sale of securities in some form or other, are held intact and not merged with current operating funds. The valuation of materials and supplies is largely one of inventory and pricing. This analysis therefore is confined purely to a determination of the necessary amount of cash capital for operating purposes, and represents the surplus necessary to offset the lag between expenditures and receipts.

While the expenses incurred in any given period are chargeable on the books of the utility as expenses for that period, they do not represent actual cash outlay until some later date. Similarly the revenue of the utility for any period is not the amount of money received during that period, but that which will ultimately revert to the utility from the sales of gas billed during the period. From a consideration of these facts it would appear that a study of the actual disbursements and the actual cash receipts of a utility during an extended period would give a close measure of cash working capital. The procedure is as follows:

During any one month certain expenses are incurred necessary to the production and distribution of gas. These expenses are payable in various ways, depending on the utility's credit, contracts entered into for its supplies, and other factors, and the date of their ultimate payment in cash is established. The period is then determined during which the proceeds are collected from the sale of gas for which this expense has been incurred. The analysis is then extended over a sufficient period until the overlapping of successive months' expenditures and collections has resulted in a uniform flow of receipts and disbursements, such as exists in a going concern, at which time the maximum deficit between expenditures and receipts is taken as the necessary cash working capital.

To simplify matters somewhat it will be assumed that 30 days represent an average month, that the year is made up of 12 such months and that the business transacted in each month is one-twelfth of the total year's business. As illustrative of the practical application of the method, the figures in Table I, which are representative of a large gas utility of the Pacific Coast, have been used, showing the annual and average monthly revenue and its disposition to operating expenses, reserves and return on investment.

TABLE I. ANNUAL AND AVERAGE MONTHLY REVENUES AND EXPENSES FOR A TYPICAL GAS UTILITY

	For the Year	For an Average Month
Receipts:		
Revenue, commercial	$3,600,000	$300,000
Revenue, municipal	216,000	18,000
Total Revenue	$3,816,000	$318,000
Disbursements:		
Return on investment	$1,236,000	$103,000
Depreciation	324,000	27,000
Taxes	216,000	18,000
Insurance	60,000	5,000
Administrative expenses	180,000	15,000
Operating expenses	1,800,000	150,000
Total	$3,816,000	$318,000

Interest, Dividends and Surplus

Proceeding to the disbursements as set forth in Table I, the item of $103,000 monthly, which represents interest, dividends and surplus, is taken as due and payable at the end of the current month. This amount is, of course, not paid out in interest and dividends at the end of the month, but is usually held, in the case of interest on bonds, until the next semi-annual or quarterly interest date, and in the case of stock until the next dividend date; but in this instance it is necessarily taken as due and payable at the end of the month whose business will ultimately contribute this amount to the net earnings. Likewise, the $27,000 depreciation is considered due and payable to the depreciation reserve at the end of the month. The $18,000 taxes and $5000 insurance are due and payable to the taxes-accrued account and to the insurance reserve respectively at the end of the month. This total of $153,000, covering re-

turn, depreciation, taxes and insurance, represents a considerable part of the working-cash capital as later determined, so that the final figure is dependent largely upon the assumption of the date at which this $153,000 can be removed from the available cash of the company and be paid either to the stockholders, bondholders, surplus or reserves.

The next item, $15,000 administrative expenses, is made up of approximately $12,000 salaries, which, according to the system of payments in vogue with the utility, is due and payable to its employees on the last working day of the current month, and $3000 expense largely in the nature of bills payable, including the materials and supplies used, which are payable during the next month approximately as follows: On the 5th of the next month, $600; on the 10th, $600; on the 15th, $600; on the 25th, $1200; total, $3000.

Maintenance and Operating Accounts

The remaining $150,000 operating expenses cover all charges to maintenance of plant and operating accounts. A study of these operating accounts for a period of one year shows that, excluding rent for an office building, the disbursements are segregated as follows: Payroll charges, 41.1%; bills payable, 11.6%; fuel oil for gas, 39.9%; petty disbursements covering materials and supplies, 7.4%; total, 100%. Applying these to the average month's expenses, $150,000 less $2500 rent, the following amounts below represent the different types of disbursements in an average month: Payroll disbursements, $60,600; bills payable, $17,100; fuel oil, $58,900; other materials and supplies, $10,900; subtotal, $147,500; rent, $2500; total, $150,000.

These being the expenses assignable to an average month's operation, the next step will be to determine how and when these amounts are actually paid out. An examination of the payrolls for an extended period shows that 52.4% represents wages earned by plant and distribution employees, payable twice a month in accordance with statute, as follows: Wages earned from the 1st to the 15th of the month are paid on the 20th of the current month; wages earned from the 16th to the 30th of the month are paid on the 5th of the following month. The remaining 47.6% of the average monthly payroll represents wages earned by office employees and those on a regular monthly salary, paid on the last working day of the month for the current month's services. The actual outlay of cash, therefore, to cover this $60,600 average monthly payroll is as follows: Plant and distribution (first half of month), payable on the 20th of the current month, 26.2%, or $15,900; monthly salaries, payable on the 30th of the current month, 47.6%, or $28,800; plant and distribution (second half of month), payable on the 5th of the following month, 26.2%, or $15,900; total, 100.0%, or $60,600.

The next item, bills payable, consists of miscellaneous expenses incurred during the month. Excluding teaming, the large single amount payable in this manner is for street-lighting expense based on a contract for the lighting and maintenance of gas street lamps. This averages about $8000 monthly, which is not paid, however, until the city has paid its street-lighting bill to the utility for the same month in which this expense is incurred. It is also found from an investigation of the bills-payable accounts that the largest number of vouchers are passed upon for approval and payment during the last week of the month.

Normally the company's credit does not extend beyond 30 days, except for the street-lighting expense bill, and considering that the vouchers audited accumulate faster at the end of the month than at the beginning, we have the following schedule showing the amount and date of payment of bills payable during any month: On the 5th of the next month, $1500; on the 10th, $1500; on the 15th, $2100; on the 25th, $4000; on the 5th of the second month following, $8000; total, $17,100.

The 5th, 10th, 15th and 25th are the dates on which vouchers are finally paid after having been passed up for audit, approval, signature and disbursement. The time elapsing between the receipt of a bill and its final payment is consumed in the checking and approval of prices and terms, the checking and approval of the material received in accordance with the invoice, the auditing and passing by the local district charged with the same, and the auditing, approval, signature and disbursement by the main office finally. In this instance a maximum of 30 days credit on all bills has been allowed.

The average month's oil bill of $58,900 is, in accordance with the terms of the utility's contract for oil, due and payable on the 15th day of the month following its purchase. Since oil is purchased far ahead of its immediate use and the amount of oil in storage is allowed in a rate base under "Materials and Supplies on Hand," it is assumed that the materials-and-supplies account would be reimbursed for the oil used in any month on the 15th of the following month.

Other materials-and-supply disbursements, totaling $10,900 monthly, are payable as follows: On the 5th of the following month, $2200; on the 10th, $2200; on the 15th, $2500; on the 25th, $4000; total, $10,900.

Rent, $2500 monthly, is due and payable on the last day of the month for the current month.

Expenses and Dates of Payments

Thus all the expenses incurred in any one month and the dates of the subsequent payment have been accounted for. These are summarized in Table II, which shows for each item of disbursements the date due and payable, and the total amounts due and payable on the various dates. The accumulative totals are also shown and will be used later.

We now proceed to a study of the collections to fix the rate at which the utility's cash accrues. The reading of meters, billing and collecting are continuous in the case of this utility, in that meters are read, bills are rendered and collections are made every working day in the month. Having taken thirty days as an average month, it will not result in any material difference for the purposes of this analysis for us to assume that each day's business contributes equally to the monthly total.

By reason of the fact that meters are read every day in the month in approximately the same numbers, it will be seen that the revenue from the sale of gas for

TABLE II. EXPENSE INCURRED IN CURRENT MONTH AND DATE OF ACTUAL DISBURSEMENTS

	Expense Incurred in Current Month		Due and Payable On						
			Current Month (January)		Next Month (February)				Second Following Month (March)
Item	Item	Detail	20th	30th	5th	10th	15th	25th	5th
Return on investment	$103,000	$103,000		$103,000					
Depreciation	27,000	27,000		27,000					
Taxes	18,000	18,000		18,000					
Insurance	5,000	5,000		5,000					
Administration expense	15,000								
Salaries		12,000		12,000					
Vouchers, etc		3,000			$600	$600	$600	$1,200	
Operating Expenses	150,000								
Payroll		60,600	15,900	28,800	15,900				
Vouchers		17,100			1,500	1,500	2,100	4,000	8,000
Oil		58,900					58,900		
Material and Supplies: Disbursements		10,900			2,200	2,200	2,500	4,000	
Rent		2,500		2,500					
Totals	$318,000	$318,000	$15,900	$196,300	$20,200	$4,300	$64,100	$9,200	$8,000
Cumulative totals of disbursements			$15,900	$212,200	$232,400	$236,700	$300,800	$310,000	$318,000

which expense has been incurred in any month has not been accounted for on the meters until the end of the next month; consequently the total revenue for which expense has been incurred in any month could not, under the most favorable conditions, be in the hands of the utility before the end of the next month. There is, however, a lapse of six days between the reading of a meter and the presentation of a bill to the consumer by the collector. This accounts for a further delay in the utility's receipts.

It is found from an examination of the collector's reports that, on the average, 40% of the bills are paid on the first presentation. This would lead to the conclusion that 40% of the revenue from the sale of gas, for which expense is incurred in any month, is available to the utility by the fifth day of the second month following. The remaining 60% is not entirely in the hands of the utility until the fifth day of the fourth month following; that is, the entire revenue from gas sold for which expense was incurred in the month of January is not collected until the fifth of May. The 40% of bills collected on first presentation, amounting to $120,000, accrues in approximately equal amounts each day from Jan. 6 to March 5 (for example). The remaining 60%, or $180,000, is payable to the company in approximately equal amounts daily from Jan. 6 to May 5.

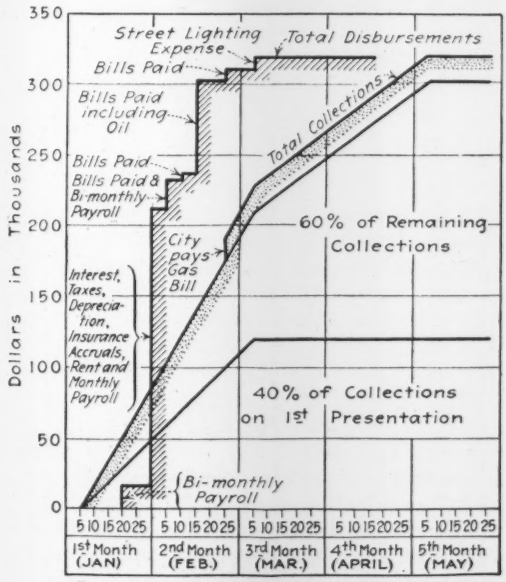


FIG. 1. LAG OF RECEIPTS BEHIND DISBURSEMENTS FOR A SINGLE MONTH AS SHOWN BY CUMULATIVE CURVES APPLICABLE TO THAT MONTH

The city pays its gas street-lighting bill, averaging $18,000 per month, on the 25th of the month following. In reality the date of payment of the city's gas bill varies from the 22nd to the 29th of the month following its use, but for this we can assume an average date of payment, which has been taken as the 25th.

From the foregoing the daily accumulation of cash can be built up. Table III shows the accumulated collection of revenue from gas sold, for which expense was incurred in the month of January (for example). By the use of figures of total accumulated disbursements from Table II, and total accumulated collections from Table III, the curves shown on Fig. 1 have been platted, showing graphically the lag of receipts behind disbursements for a single month.

TABLE III. ACCUMULATED COLLECTIONS FROM BILLS FOR GAS SOLD FOR WHICH EXPENSE WAS INCURRED IN FIRST MONTH (JANUARY)

	40% Collections on Presentation of Bill	Remaining Collections Commercial Bills	Municipal Sales Collections	Total to Date
Jan. 5	$10,000	$7,500		$17,500
10	20,000	15,000		35,000
15	30,000	22,500		52,500
20	40,000	30,000		70,000
30	50,000	37,500		87,500
Feb. 5	60,000	45,000		105,000
10	70,000	52,500		122,500
15	80,000	60,000		140,000
20	90,000	67,500		157,500
25	100,000	75,000	$18,000	193,000
28	110,000	82,500	18,000	210,500
Mar. 5	120,000	90,000	18,000	228,000
10	120,000	97,500	18,000	235,500
15	120,000	105,000	18,000	243,000
20	120,000	112,500	18,000	250,500
25	120,000	120,000	18,000	258,000
30	120,000	127,500	18,000	265,500
Apr. 5	120,000	135,000	18,000	273,000
10	120,000	142,500	18,000	280,500
15	120,000	150,000	18,000	288,000
20	120,000	157,500	18,000	295,500
25	120,000	165,000	18,000	303,000
30	120,000	172,500	18,000	310,500
May 5	120,000	180,000	18,000	318,000
10	120,000	180,000	18,000	318,000
15	120,000	180,000	18,000	318,000
20	120,000	180,000	18,000	318,000

The next step will be to project these figures of cumulative disbursements and cumulative collections for a period of six months, until such a time as we have reached a condition of uniformity of receipts and disbursements and a repeated deficiency of the same amount at the same time during consecutive months. Using the figures shown in Table II as applicable to January, then February's cumulative disbursements will

be the same as January's, but due and payable 30 days later. The cumulative disbursements for March, April and May will be due and payable 60, 90 and 120 days respectively after the corresponding payments for the month of January. Table IV has been thus constructed, showing the accumulated disbursements for the expense incurred in the months of January to May, inclusive, and the total accumulated disbursements to any date of this period. Similarly Table V has been computed, showing the accumulated collections of revenue for gas

TABLE IV. ACCUMULATED DISBURSEMENTS

Due and Payable on		Expense Incurred in Month of January	February	March	April	May	Total to Date
Jan.	20	$15,900					$15,900
	25	15,900					15,900
	30	212,200					212,200
Feb.	5	232,400					232,400
	10	236,700					236,700
	15	300,800					300,800
	20	300,800	$15,900				316,700
	25	310,000	15,900				325,900
	28	310,000	212,200				522,200
Mar.	5	318,000	232,400				550,400
	10	318,000	236,700				554,700
	15	318,000	300,800				618,800
	20	318,000	300,800	$15,900			634,700
	25	318,000	310,000	15,900			643,900
	30	318,000	310,000	212,200			840,200
Apr.	5	318,000	318,000	232,400			868,400
	10	318,000	318,000	236,700			872,700
	15	318,000	318,000	300,800			936,800
	20	318,000	318,000	300,800	$15,900		952,700
	25	318,000	318,000	310,000	15,900		961,900
	30	318,000	318,000	310,000	212,200		1,158,200
May	5	318,000	318,000	318,000	232,400		1,186,400
	10	318,000	318,000	318,000	236,700		1,190,700
	15	318,000	318,000	318,000	300,800		1,254,800
	20	318,000	318,000	318,000	300,800	$15,900	1,270,700
	25	318,000	318,000	318,000	310,000	15,900	1,279,900
	30	318,000	318,000	318,000	310,000	212,200	1,476,200
June	5	318,000	318,000	318,000	318,000	232,400	1,504,400
	10	318,000	318,000	318,000	318,000	236,700	1,508,700

TABLE V. ACCUMULATED COLLECTIONS FOR GAS SOLD

		Expense Incurred in Month of January	February	March	April	May	Total to Date
Jan.	5						
	10	$17,500					$17,500
	15	35,000					35,000
	20	52,500					52,500
	25	70,000					70,000
	30	87,500					87,500
Feb.	5	105,000					105,000
	10	122,500	$17,500				130,000
	15	140,000	35,000				175,000
	20	157,500	52,500				210,000
	25	193,000	70,000				263,000
	28	210,500	87,500				298,000
Mar.	5	228,000	105,000				333,000
	10	235,500	122,500	$17,500			375,500
	15	243,000	140,000	35,000			418,000
	20	250,500	157,500	52,500			460,500
	25	258,000	193,000	70,000			521,000
	30	265,500	210,500	87,500			563,500
Apr.	5	273,000	228,000	105,000			606,000
	10	280,500	235,500	122,500	$17,500		656,000
	15	288,000	243,000	140,000	35,000		706,000
	20	295,500	250,500	157,500	52,500		756,000
	25	303,000	258,000	193,000	70,000		824,000
	30	310,500	265,500	210,500	87,500		874,000
May	5	318,000	273,000	228,000	105,000		924,000
	10	318,000	280,500	235,500	122,500	$17,500	974,000
	15	318,000	288,000	243,000	140,000	35,000	1,024,000
	20	318,000	295,500	250,500	157,500	52,500	1,074,000
	25	318,000	303,000	258,000	193,000	70,000	1,142,000
	30	318,000	310,500	265,500	210,500	87,500	1,192,000
June	5	318,000	318,000	273,000	228,000	105,000	1,242,000
	10	318,000	318,000	280,500	235,500	122,500	1,292,000*

* Includes 17,500, June 10.

sold for which expense was incurred in these same months, and the total accumulated collections to date.

Taking the total accumulated disbursements to any date from Table IV, and the total accumulated collections to the same date from Table V, the deficit existing by reason of the lag of receipts behind expenditures is easily fixed. This is shown in Table VI. It will be noted that from the middle of April (January being taken as the initial point) the same deficits occur on the same date of each succeeding month. We have thus arrived at a state of uniform flow of receipts and disbursements,

TABLE VI. CASH DEFICITS WITHOUT WORKING CAPITAL AND SURPLUS WITH WORKING CAPITAL

		Accumulated Disbursements	Accumulated Cash	Cash Deficit	Accumulated Cash Plus Working Capital	Cash Surplus With Working Capital
Jan.	0	.....	.....	.....	$284,200	$284,200
	5	.....	.....	.....	284,200	284,200
	10	.....	$17,500	$17,500*	301,700	301,700
	15	.....	35,000	35,000*	319,200	319,200
	20	$15,900	52,500	36,600*	336,700	320,800
	25	15,900	70,000	54,100*	354,200	338,300
	30	212,200	87,500	124,700	371,700	159,500
Feb.	5	232,400	105,000	127,400	389,200	156,800
	10	236,700	130,000	106,700	414,200	177,500
	15	300,800	175,000	125,800	459,200	158,400
	20	316,700	210,000	106,700	494,200	177,500
	25	325,900	263,000	62,900	547,200	221,300
	28	522,200	298,000	224,200	582,200	60,000
Mar.	5	550,400	333,000	217,400	617,200	66,800
	10	554,700	375,500	189,200	659,700	95,000
	15	618,800	418,000	200,800	702,200	83,400
	20	634,700	460,500	174,200	744,700	110,000
	25	643,900	521,000	122,900	805,200	151,300
	30	840,200	563,500	276,700	847,700	7,500
Apr.	5	868,400	606,000	262,400	890,200	21,800
	10	872,700	656,000	216,700	940,200	67,500
	15	936,800	706,000	230,800	990,200	53,400
	20	952,700	756,000	196,700	1,040,200	87,500
	25	961,900	824,000	137,900	1,108,200	146,300
	30	1,158,200	874,000	284,200	1,158,200	0
May	5	1,186,400	924,000	262,400	1,208,200	21,800
	10	1,190,700	974,000	216,700	1,258,200	67,500
	15	1,254,800	1,024,000	230,800	1,308,200	53,400
	20	1,270,700	1,074,000	196,700	1,358,200	87,500
	25	1,279,900	1,142,000	137,900	1,426,200	146,300
	30	1,476,200	1,192,000	284,200	1,476,200	0
June	5	1,504,400	1,242,000	262,400	1,526,200	21,800
	10	1,508,700	1,292,000	216,700	1,576,200	67,500

* Surplus.

and it is found that on the thirtieth day of each month beginning with April, there exists a deficit of $284,200. This represents the minimum requirement in the form of cash necessary to offset the lag between receipts and expenditures, for if this amount be initially in the hands of the company there will always be sufficient funds to meet the current disbursements as they fall due and payable. This amount will be periodically exhausted at the end of each month, leaving no margin for unusual conditions that might arise. To this should, of course, be added a sufficient amount to offset contingencies.

The accumulated disbursements from Table IV, collections from Table V, and deficits without working cash capital and surplus with working cash capital from Table VI are shown graphically in Fig. 2, the upper line on this chart showing the working-cash capital plus accumulated collections, which is always ahead of accumulated disbursements except on the last days of the months of April and May and thereafter.

The procedure under which this figure has been deduced represents very closely the actual conditions under

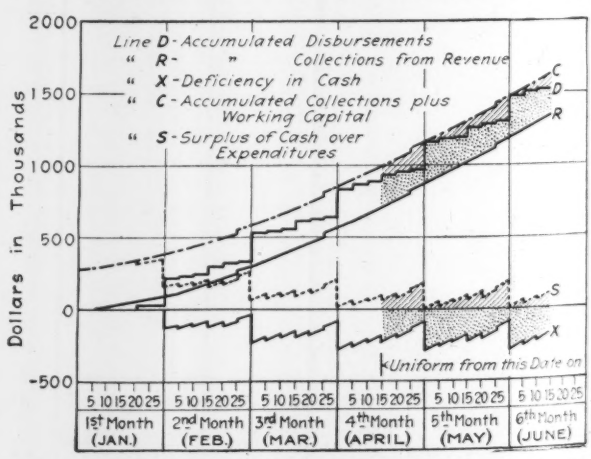


FIG. 2. GRAPHICAL REPRESENTATION OF WORKING CAPITAL TO TAKE CARE OF MAXIMUM LAG

which the ultility in question receives and pays out its funds. It may appear that the assumption of a succession of average months is not warranted, and that consideration should be given to the variation of expenses and revenue from month to month. In an examination of the revenue and expense each month for any 12 months period, it is found that the ratio of expense to revenue is least in those months of maximum expense and maximum revenue, and consequently, in a less ratio than that of an average month representing one-twelfth of a year; so that the assumption of an average month's receipts and expenses as used yields a result slightly in excess of that which would result from taking a month-to-month variation.

The final figure of working-cash capital, $284,200, is based upon the very vital assumption that an amount of $153,000 for return, depreciation, taxes and insurance is deducted from income at the end of the month during which this expense was incurred, whether or not there is cash available from collections for this purpose. If this deduction is postponed 30 days the requirements of working capital will be reduced to $131,200, and further, if the deduction of these earnings and reserves is postponed 60 days, then cash on hand is always in excess of disbursements and no cash working capital is required.

It is the writer's conviction that an analysis of this character, based on the existing practice of a utility in collecting its revenues and disbursing its expenses, affords a very close measure of working cash capital, for operating purposes, as one of the items to be included in a rate base.

Small Army Warehouses Built with Speed and Economy

One-Story Timber Frame Buildings for Overseas Shipments Are of Simple Design Which Permitted Rapid Erection

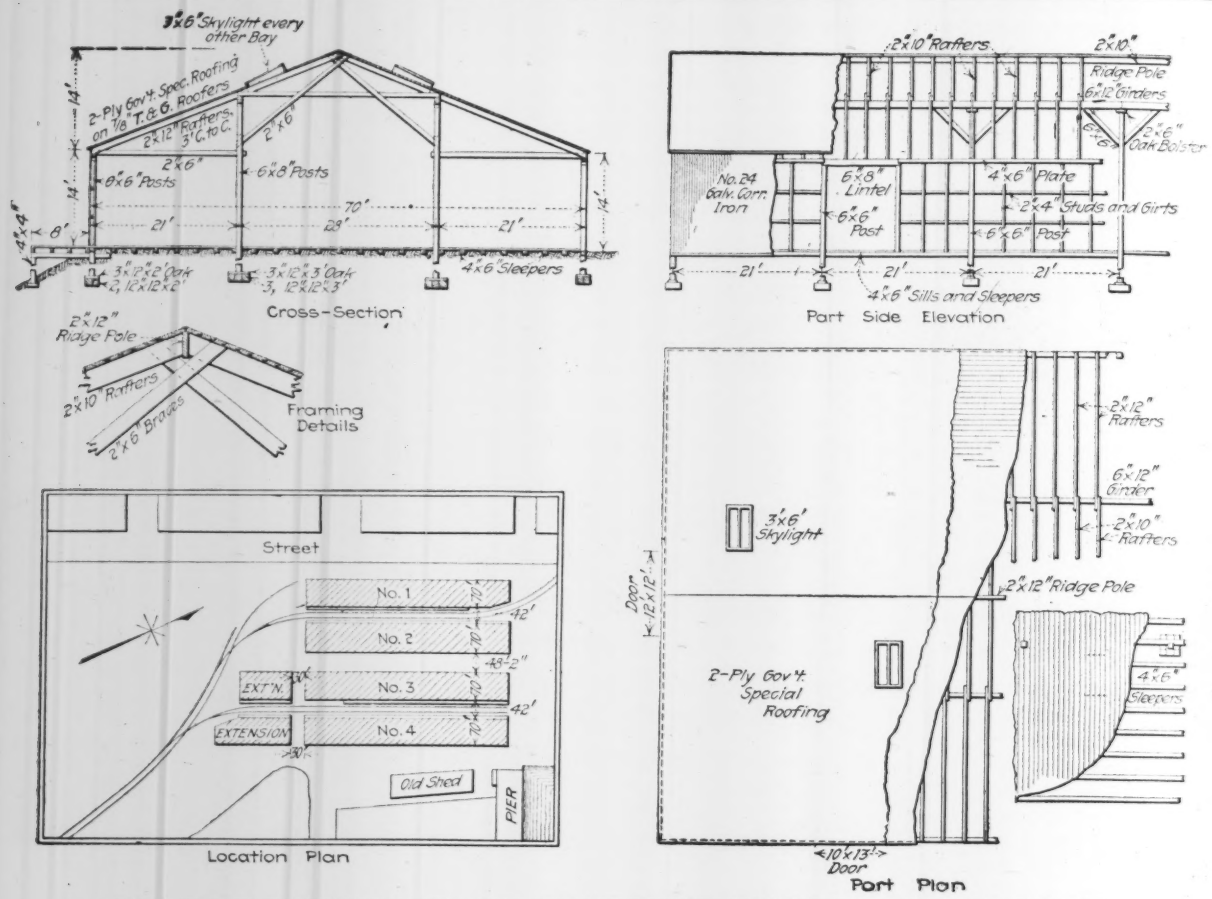
FIRST building the side bays of long one-story timber sheds so that the central bays could be framed from the parts already erected was an important factor in the rapid construction of one group of army warehouses last winter. Special design to aid rapid construction and the arrangement of work to permit the different classes of workmen to follow in successive waves were contributing elements of success. Last winter the enormous flow of assorted freight to the overseas transport terminals resulted in a demand for the immediate construction of shelter and storage, more or less temporary, to permit the rapid unloading of freight cars and to relieve the congestion in the overtaxed warehouses convenient to the transport piers. This group of warehouses, at one of the Atlantic ports, was built in a very short time and at a cost quite low for these times.

THIS GROUP OF WOOD-FRAME ARMY WAREHOUSES WAS COMPLETED IN FORTY-TWO DAYS

On the accompanying drawing a general layout of the warehouse site is given. The group comprised four main one-story warehouses, with two minor extensions, each unit being 70 x 504 ft. in plan. Each building was roofed and inclosed with sheathing, except for one end of one warehouse, which was left unsheathed, though roofed.

As shown by the plan, the group of buildings was served by car tracks between them, with driveways on the opposite sides. With this arrangement, cars from the inland side loaded with merchandise can be switched between buildings without delay, the goods placed herein for storage and subsequently delivered by motor truck to various steamship piers. If destined for reconsignment by car, the freight can be readily reloaded, as between each track and the building it serves is an open loading platform 8 ft. wide which eliminates spotting the car doors to coincide with the doors of the sheds. At the ends of each warehouse are extra large doors with sufficient clearance to pass the large army trucks. Goods, as a rule, are stored in side aisles of the buildings, the center portion serving as a driveway for these trucks, and the side doors are used principally for the handling of material to and from the cars.

In studying the design the following considerations governed: In the buildings all trusses and other heavy elements requiring special plant or elaborate preparations for erection were eliminated; a design was selected that would permit the use of timbers of minimum sizes, by taking advantage of a steep roof slope



WOOD-FRAME WAREHOUSES FOR ARMY STORAGE WHICH WERE BUILT RAPIDLY AND CHEAPLY

with lighter roof loads, and by reducing the usual factors of safety provided in more permanent frame structures; the timber members of the framework had to be of sizes and lengths readily obtainable from local lumber stock. On this basis the design shown in the detail drawings herewith was evolved.

All timber members of the framework were of shortleaf pine, spruce or hemlock, excepting the interior posts, the 6 x 12-in. girders and the 12 and 10-in. rafters. To permit rapid construction in the freezing weather of last winter, concrete footings were eliminated and 12 x 12-in. timbers, with oak caps, substituted therefor, though in milder weather and with materials for concreting readily obtainable these spread footings would preferably be of a 1:3:6 concrete mixture. To avoid excavating frozen ground, floor elevations were selected for the buildings that permitted cinder and dirt fill to form the foundations for the floor sleepers on which 2-in. flooring was laid. These elevations resulted in a floor level about team height on one side and, by a slight depression of the railroad tracks, at car floor level on the other side.

ROOFERS ON SIDE BAYS BEFORE ERECTING CENTER

The steep pitch of the roof permitted satisfactory use of 2-ply ready roof laid with the seams well cemented on top. The skylights were of metal, glazed with ribbed glass, with metal flashing. The rain and snow run-offs were permitted to discharge over the roof edge, except at the doors, where 2 x 4 in. rain deflectors form a triangle on the roof over each door. The buildings were sheathed with 24-gage galvanized metal for siding; the exterior of the doors and jambs and door heads were covered with 26-gage metal.

Electrical wiring was of the open type, the down switch connections therefor being in conduits to avoid short circuiting through accidental pressure of freight. In each central bay, just below the horizontal 2 x 6-in. girders, were placed two 200-watt lights, and over the end doors were placed exterior lights, so that the buildings are lighted for the handling of freight at any time. Delivery of materials was the most worrisome construction problem and in spite of the fact that a large

lumber yard was located within half a mile of the site, the greatest effort only kept a half-day's supply of lumber ahead. The Quartermaster Department coöperated in many ways to expedite delivery of materials, sending, for instance, an extra army transport train of 15 motor cars 40 miles to bring roofing materials. A large consignment was due any day and extensive preparations had been made to store this under canvass, but by increased effort one warehouse was ready in nine days and could accommodate the shipment.

The general planning of the work and the organization included subdividing the different items of work under foremen responsible for only one particular task.

SIDE BAYS FRAMED FIRST TO PERMIT SHEATHING TO BE PLACED ON OUTSIDE WALLS

Thus, from start to finish about 150 carpenters were apportioned to five foremen. One foreman would have full charge of erection of posts and studs, the next girders, then rafters, and so on. A gang of laborers was started on the excavation work in January, during some of the coldest weather known for years. The second day after they went to work carpenters were erecting posts, and the work progressed as planned.

In constructing these buildings, as the photographs show, the studs, all posts and girders and the rafters of the two outside bays were erected for the full length of the building; then the ridgepole and center rafters were erected from a light scaffold placed in the center bay, partly formed on the permanent 2 x 6-in. horizontal braces. This method of construction permitted the sheet metal to be placed and the doors to be hung while the central part of the buildings was being finished. At the same time the ⅞-in. roof boards were being laid on the side bays.

As soon as the rafters and the ridge poles were in place, the scaffolding was removed and the floor was commenced with placing of the sleepers, followed right behind by a separate gang of workmen who filled in the earth and laid the flooring. A steam shovel was used to excavate the cut for the tracks and the material taken out, together with more from a borrow pit, was used in the floor fill.

This group of warehouses was let in two contracts, buildings Nos. 1 and 3 forming the first contract. These two buildings, 500 x 70 ft. in plan, were completed in 23½ working days. The first two buildings complete cost $1.07 per square foot, the buildings themselves costing 84½c., the grading 20c. and the electrical work 2½c. The second group of buildings cost 86½c. per square foot, the buildings themselves costing 76c., the grading 9.4c. and the electrical work 1.1 cent.

The design and construction were under the general direction and supervision of the Cantonment Division then existing, Quartermaster Department, U. S. A., with Lieut. Col. D. H. Sawyer in charge. The constructing quartermaster directly in charge of this work and largely responsible for its rapid progress was Capt. William B. Ashby, with whom, in charge of accounts, was A. T. Powers. The contractor, who also had a large part in preparing the design, was the Barney-Ahlers Construction Corporation, of New York City. The coöperation and efficiency in accounting of the government representatives were of material aid in expediting the work. All materials and labor and the contractor's fee were paid within one week after the job was done.

Shorter and Simpler Charter for Detroit

BREVITY and relative simplicity are believed to feature a new charter for the city of Detroit which will be submitted to the voters June 25. The document contains 150 pages; there are 800 in the present charter. The new charter provides for a council of nine members, elected at large, in place of 42 elected two each from 21 wards. The mayor would appoint all commissioners and boards, without confirmation by the council. He would form the budget and the council could override only by a vote of seven of the nine members his veto of budget items. Provision is made for the initiative and referendum, and for the recall of elective officers. Municipal ownership is left to the decision of the voters, as now.

Organization of the Department of Public Works has not been materially changed, but definite authority is given to it, as follows: It will have power to establish and operate plants for the manufacture of brick and creosote block. It may bid on the construction of pavements and sewers, and if low bidder shall receive the contract. Cutting into pavements, after due notice of intent to pave has been given, is discouraged by the provision that all persons cutting into new pavements must pay treble the cost of restoration the first year and double the cost the second year after the paving.

The Board of Water Commissioners is required to submit an annual budget to the city. Under the present charter it is independent of financial control.

A central purchasing system is established under a commissioner who is to buy all supplies, materials and equipment for the city departments on specifications furnished by the departments and approved by the council. Standard specifications are to govern where two or more departments use similar materials.

Building inspection is centralized under a single commissioner in charge of building, safety, engineering and permits. All permits required for building, engineering, plumbing, lighting and health shall be issued by the permit bureau on authority of departments concerned.

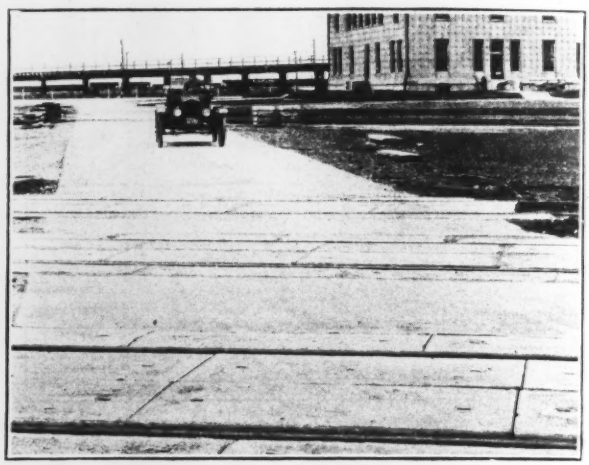
A city-plan commission is to have the power, on approval of the council, to divide the city into zones in order to govern the type, height and use of buildings in each zone. The commission shall consist of nine members, to include an architect, a civil engineer, a structural engineer, a real estate dealer, a builder, an attorney and a physician.

Concrete Railroad Crossings Proving Successful

Slabs Found Cheap, Durable and Easily Removable —Iron-Bound Edges Resist Wear—Concrete Planks Also Used

REINFORCED-CONCRETE slabs for paving railway crossings in streets are said to be proving a satisfactory substitute for the wood planks commonly used. They provide a hard and durable surface, forming a continuation of the street paving, but they can be removed readily to permit surfacing or repairing of the tracks. Slabs 24½ in. wide and 8ft. long, with thickness equal to the height of the rail, were designed by T. F. McCauley, city engineer of Cedar Rapids, Iowa, and laid in 1915, as described in *Engineering Record* of March 11, 1916, p. 350. Mr. McCauley says that these slabs are in good condition, and that the division engineers of three railways adopted this construction for other crossings in that city.

8-FOOT SLABS AT CEDAR RAPIDS CROSSING

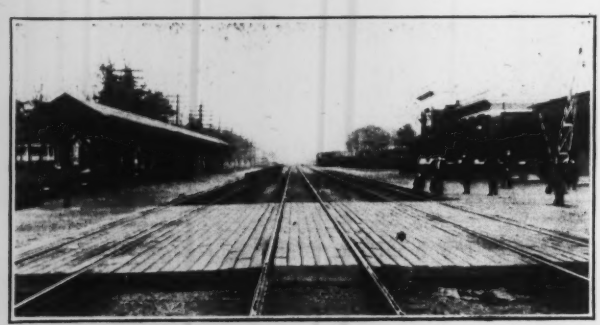


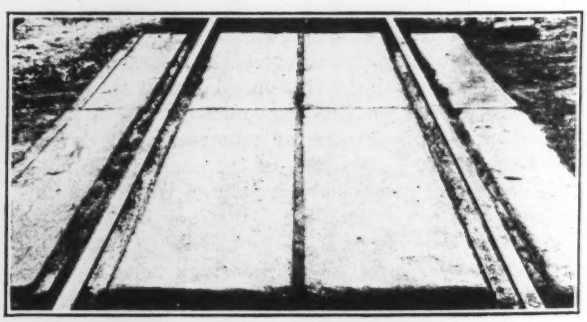
5½-FOOT SLABS AT BUFFINGTON

Paving slabs of this type, but with modifications as shown in the accompanying drawing, have been used on more than 20 crossings at the Buffington (Ind.) plant of the Universal Portland Cement Co. Special features of the design are the steel protection plates on all exposed edges and the use of a rounded corner at the flangeway. The side plates are considered especially desirable when much steel-tired traffic is carried, and the latest slabs used at Cedar Rapids are protected in this way. The plates are thought preferable to bituminous filling of the joints, but this filling may be used in addition.

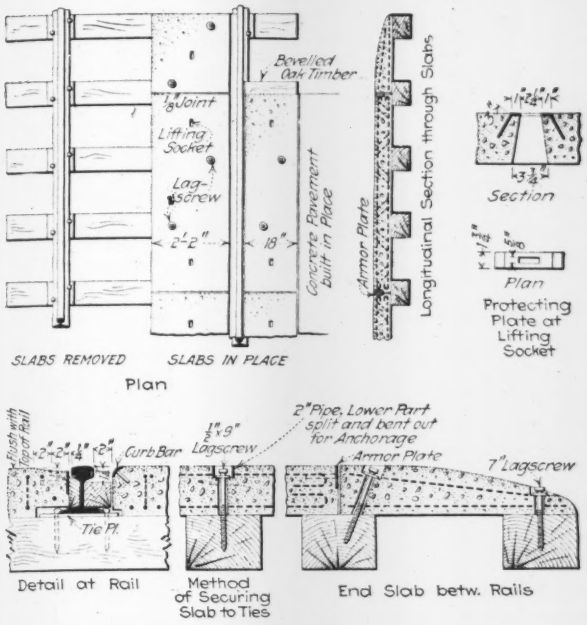
In the construction shown by the drawing, two rows of slabs 26 in. wide are placed between the rails, and a single row of 18-in. slabs is outside of each rail. They are in lengths of 5½ ft. Shorter end slabs with inclined surfaces are placed between the rails to prevent loose brake rigging or other hanging parts from catching on the crossing. Concrete paving poured in place is shown for the space between the tracks. As noted above, the slabs are made of a thickness equal to the height of the rail, and are laid directly upon the ties, which have been tamped to a firm support and level surface. They are secured to the ties by lagscrews in cored holes.

Recessed sockets provide for inserting lewis bolts for handling the slabs by bars or crane slings. These sockets and the holes for lagscrews are protected by steel plates. The reinforcement of the slab consists of straight and bent bars with hooked ends. The concrete is a 1 : 2 : 3 mix. Flangeways are shown with a wood filling strip, but the Cedar Rapids crossings have steel rails laid flat, with their heads against the webs of the track rails. A plank filler keeps the outer slab from contact with the





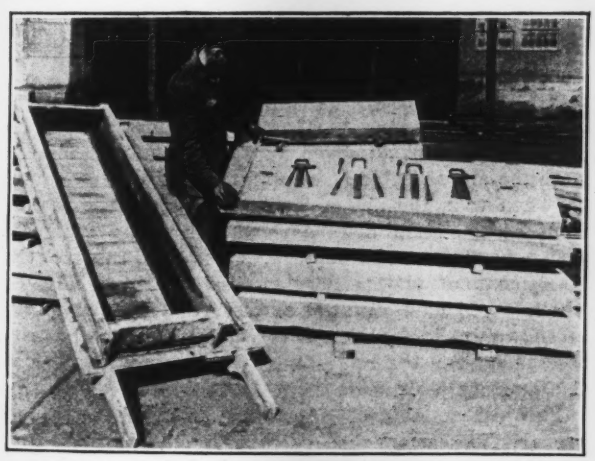
SLAB CROSSING LAID AT CEDAR RAPIDS IN JUNE, 1915—CONCRETE PLANKS AT DOWNERS GROVE, ILL.



DETAILS OF IRON-BOUND SLABS FOR CROSSINGS

rail, and experience is said to have shown the desirability of this as a protection for the slab.

The forms for the Buffington slabs consist of two channels with two end boards between them, the channels being held together by tie-rods at the ends. Two sets of end boards of different lengths provide for making slabs of the two widths employed. The form is placed on a wood panel, and may be removed in a few hours



PORTABLE FORM FOR MAKING CONCRETE SLABS
Lewis bolts shown ready for placing in sockets for handling

after the concrete is poured, the slab then remaining on the panel for the required time.

Concrete planks, rather than slabs, have been used for paving crossings on the Chicago, Burlington & Quincy R.R. The planks, which are made at the company's yards, are 4¾ x 8 in., in 8-ft. lengths. They are laid on filler strips on the ties, to bring them level with the rail heads, but those in the spaces between the tracks are laid on a sand cushion. Beveled timbers along each side of the crossing hold the planks in place.

Paving and Grading Assessments on Simple Basis

Standard Method in Use for Four Years Has Given Satisfaction to Property Owners in Practically All Cases

By George H. Ruhling
Office Engineer, City Engineer's Office, Flint, Mich.

NUMEROUS and quite varied in character were the methods of making assessments for paving or grading in the city of Flint, Mich., prior to 1914. Naturally there resulted considerable dissatisfaction among property owners and the public in general. W. R. Drury, who was then city engineer and who had to bear the brunt of the complaints, found that his predecessor, H. E. Terry, had started a standard method for figuring assessment ratings which, upon thorough investigation, proved to be worth while. This method was developed and put in use, and after four years' trial has been found to give reasonable satisfaction.

In Flint all paving and grading are assessed on the property except that done at street intersections, which is paid for by the city at large. The paving includes curb and gutter work, grading, foundation, and surface, but does not include sanitary sewers, storm sewers, catchbasins or inlets, the cost of which is taken care of by other means. The property is assessed half way back to the next street each way. A board of three assessors, who are property owners and residents of the city, is appointed by the city council to make and review the assessment in question. The chairman of this board is usually appointed from the members of the city engineer's office, as all the records of the assessments are kept in that office. The three accompanying tables,

TABLE I. RATE OF ASSESSMENT VARIES FROM FRONT TO BACK ACCORDING TO DEFINITE FORMULA

1	0.02754	51	1.01377	101	1.50688	151	1.75344	201	1.87672	251	1.93836
2	0.05470	52	1.02735	102	1.51368	152	1.75684	202	1.87842	252	1.93921
3	0.08148	53	1.04074	103	1.52037	153	1.76018	203	1.88009	253	1.94004
4	0.10789	54	1.05394	104	1.52697	154	1.76348	204	1.88174	254	1.94087
5	0.13394	55	1.06697	105	1.53348	155	1.76674	205	1.88337	255	1.94168
6	0.15963	56	1.07982	106	1.53991	156	1.76996	206	1.88498	256	1.94249
7	0.18464	57	1.09232	107	1.54616	157	1.77308	207	1.88654	257	1.94327
8	0.20995	58	1.10498	108	1.55249	158	1.77624	208	1.88812	258	1.94406
9	0.23460	59	1.11730	109	1.55865	159	1.77932	209	1.88966	259	1.94483
10	0.25890	60	1.12945	110	1.56472	160	1.78236	210	1.89118	260	1.94559
11	0.28287	61	1.14144	111	1.57072	161	1.78535	211	1.89268	261	1.94634
12	0.30651	62	1.15326	112	1.57663	162	1.78832	212	1.89416	262	1.95708
13	0.32983	63	1.16492	113	1.58246	163	1.79123	213	1.89562	263	1.94781
14	0.35287	64	1.17644	114	1.58822	164	1.79441	214	1.89706	264	1.94853
15	0.37550	65	1.18775	115	1.59388	165	1.79694	215	1.89847	265	1.94923
16	0.39787	66	1.19894	116	1.59947	166	1.79974	216	1.89987	266	1.94933
17	0.41993	67	1.20996	117	1.60498	167	1.80249	217	1.90124	267	1.95062
18	0.44167	68	1.22084	118	1.61042	168	1.80521	218	1.90260	268	1.95130
19	0.46313	69	1.23156	119	1.61578	169	1.80789	219	1.90394	269	1.95197
20	0.48429	70	1.24214	120	1.62107	170	1.81054	220	1.90527	270	1.95263
21	0.50515	71	1.25258	121	1.62629	171	1.81314	221	1.90657	271	1.95328
22	0.52573	72	1.26287	122	1.63144	172	1.81572	222	1.90786	272	1.95393
23	0.54603	73	1.27302	123	1.63651	173	1.81826	223	1.90913	273	1.95456
24	0.56605	74	1.28300	124	1.64151	174	1.82076	224	1.91038	274	1.95519
25	0.58579	75	1.29290	125	1.64645	175	1.82322	225	1.91161	275	1.95580
26	0.60526	76	1.30263	126	1.65132	176	1.82566	226	1.91283	276	1.95642
27	0.62446	77	1.31223	127	1.65612	177	1.82806	227	1.91403	277	1.95702
28	0.64340	78	1.32170	128	1.66085	178	1.83042	228	1.91521	278	1.95760
29	0.66008	79	1.33004	129	1.66502	179	1.83251	229	1.91626	279	1.95813
30	0.68050	80	1.34025	130	1.67012	180	1.83506	230	1.91753	280	1.95876
31	0.69866	81	1.34933	131	1.67466	181	1.83733	231	1.91866	281	1.95933
32	0.71658	82	1.35829	132	1.67914	182	1.83957	232	1.91978	282	1.95989
33	0.73425	83	1.36712	133	1.68356	183	1.84178	233	1.92089	283	1.96044
34	0.75168	84	1.37584	134	1.68792	184	1.84396	234	1.92198	284	1.96099
35	0.76886	85	1.38443	135	1.69222	185	1.84611	235	1.92306	285	1.96153
36	0.78581	86	1.39290	136	1.69645	186	1.84822	236	1.92411	286	1.96205
37	0.80252	87	1.40126	137	1.70063	187	1.85032	237	1.92516	287	1.96258
38	0.81800	88	1.40900	138	1.70450	188	1.85225	238	1.92612	288	1.96306
39	0.83527	89	1.41764	139	1.70882	189	1.85441	239	1.92720	289	1.96360
40	0.85130	90	1.42565	140	1.71282	190	1.85641	240	1.92820	290	1.96410
41	0.86711	91	1.43356	141	1.71678	191	1.85839	241	1.92920	291	1.96460
42	0.88271	92	1.44136	142	1.72068	192	1.86034	242	1.93017	292	1.96508
43	0.89809	93	1.44904	143	1.72452	193	1.86226	243	1.93113	293	1.96556
44	0.91327	94	1.45664	144	1.72832	194	1.86416	244	1.93208	294	1.96604
45	0.92823	95	1.46412	145	1.73206	195	1.86603	245	1.93302	295	1.96651
46	0.94299	96	1.47150	146	1.73575	196	1.86788	246	1.93394	296	1.96697
47	0.95753	97	1.47876	147	1.73938	197	1.86969	247	1.93484	297	1.96742
48	0.97188	98	1.48594	148	1.74297	198	1.87148	248	1.93574	298	1.96787
49	0.98604	99	1.49302	149	1.74651	199	1.87326	249	1.93663	299	1.96832
50	1.00000	100	1.50000	150	1.75000	200	1.87500	250	1.93750	300	1.96875

with an example, will suffice to make clear the method followed.

A section taken from a typical plan for paving is shown. All dimensions of the property are shown to a 1 in. = 50 ft. scale. Also the lot number, name of the addition, and property owner are given. The plan having been prepared, the property is then listed. We will start with Lot 5, Block 5, as shown on the plan. This happens to be a triangular piece with the apex on the street line. Turning to Table III, we find $x = 50$ ft., $y = 100$ ft.; therefore $z = x/y = 0.50$ and $rm = 58.37520$. Then the trial assessment for this piece of property is $rm\ x/y = rmz = 58.37520 \times 0.50 =$ $29.19. This amount is entered in Col. 7. The next lot listed is Lot 4, Block 5, depth 100 ft., which is listed under Col. 4. Turning to Table I for the trial one foot front assessment for 100 ft. depth, we have 1.50000. Place this in Col. 5. In Col. 6 we listed the foot frontage of the lot in question. This figure applied to Col. 5 gives the total trial assessment for Lot 4 and is placed in Col. 7.

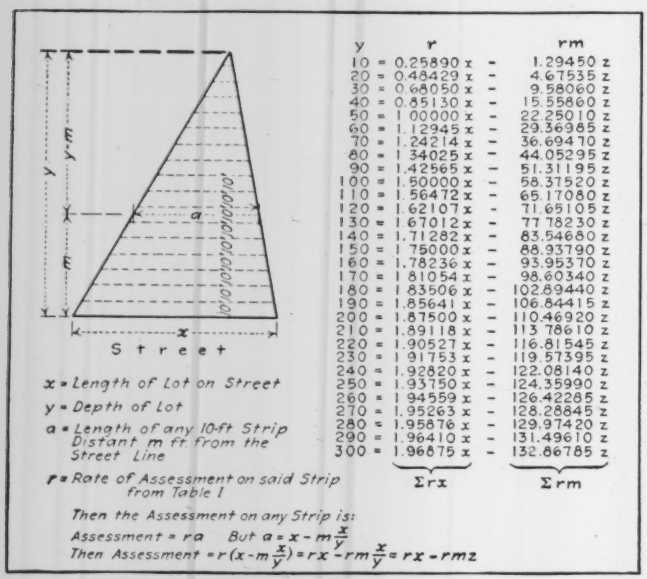
In this manner all the property is listed, and the trial assessments computed. Col. 7 is then totalled and it is found that $7600 has been raised by this assessment. This amount divided into the amount of money to be raised gives 1.605, the factor shown in Col. 8. By applying this factor to the trial assessments shown in Col. 7 the correct assessments are computed and tabulated in Col. 9. Adding these and totalling, we arrive at a figure which should equal the amount of money which it was necessary to raise. Usually, the total is very close to the correct amount, and a few additions or subtractions here and there will adjust the assessment.

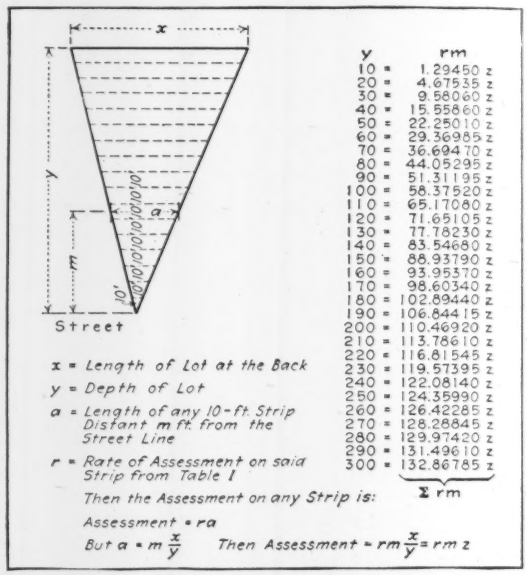
A triangular strip of property with the apex away from the street line, such as Lot 7, Block 4, is computed as is the one given in the foregoing example. With the aid of Table II we find the values of x, y, and z. Then with the aid of Table I, compute the assessment of the strip just as though it was a rectangle with a frontage x and depth y. From this, subtract the assessment of the triangular half of this rectangle which would have its apex at the street line, computed as shown in Table III. This will then leave the trial assessment for the remaining triangular half which is the quantity desired.

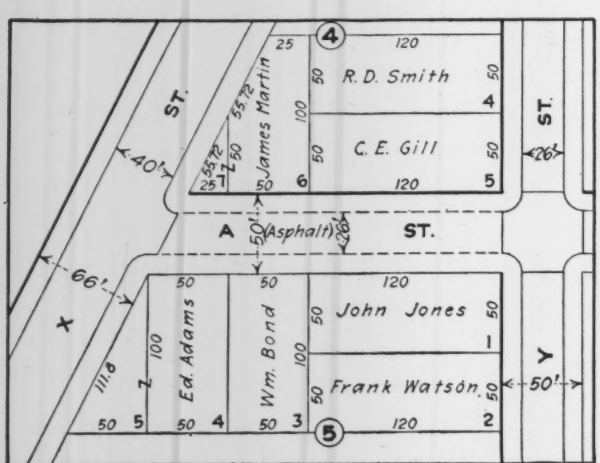
The assessment of irregularly shaped pieces of property is accomplished by dividing the property into parallelograms and triangles, and then proceeding as above.

In Tables II and III the quantities are given for increments of ten feet only. Distances between these points are interpolated. Table I gives trial assessments by one foot increments back to a distance of 300 ft. from the street line. As property is assessed only half way back to the adjoining street, this table usually covers the distance—for blocks are rarely more than 600 ft. long. However, should they be longer than 600 ft. the assessment rate at 300 ft. back is very light and distances beyond this are figured at the same rating per front foot as the rate is at 300 feet.

TABLES II AND III. ASSESSMENT OF TRIANGULAR LOTS; BASE AT STREET LINE, AND APEX AT STREET LINE







ASSESSMENT OF THESE TRIANGULAR LOTS SIMPLE BY THE METHOD DESCRIBED IN THIS ARTICLE

A résumé of the foregoing will show the following: Property adjoining the street being paved pays a higher rate than property back of it. The rate as you go back decreases according to the formula

$$y = 2 - 2\left(\frac{50 - x}{50}\right)$$

in which y = the amount of assessment in dollars, and x = the depth from the street line in feet. All

SUBJECT "A" STREET PAVING

Engineer's Office — File No. 244 — Sheet No. 1 From 1 to 5

Date 11/20/17 — Computed G.H.R. — Checked by A.P.H. C.A.J.

$12,300.00 to be Assessed

OWNER	LOT	BLK	DEPTH	1-FT. ASMT.	FRONT	AMOUNT	FACTOR	COR. AMT.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Edw. Adams	5	5	100'	Triangular Piece			1.605	
			x = 50'; y = 100'; x/y = 0.50 x m = 58.37520; therefore assessment = 58.3752 x 0.50			$29.19		$46.85
Edw. Adams	4	5	100'	1.50000	50'	75.00		120.38
Wm. Bond	3	5	100'	1.50000	50'	75.00		120.38
John Jones	1	5	50'	1.00000	120'	120.00		192.60
Frank Waturn	2	5	50'	1.50000				
				1.00000				
				50000	120'	60.00		96.30
And so on until the entire property is listed								
				Total		$7,600.00		$12,200.00

Factor = 12,200.00 / 7,600.00 = 1.605

COMPUTATIONS BY WHICH ASSESSMENTS ARE DISTRIBUTED ARE KEPT ON THIS FORM

property eventually pays a paving assessment on the two streets nearest it, and it pays on these two streets only. The amount for any piece of property is absolutely definite and fixed. This eliminates arbitrary judgment. The property at street corners pays more than property in the middle of the block.

Altogether, the system has proved quite successful, has greatly decreased the number of protests, and, in the opinion of the writer, is more equitable than the average methods pursued.

City of St. Paul to Operate on Cash Basis

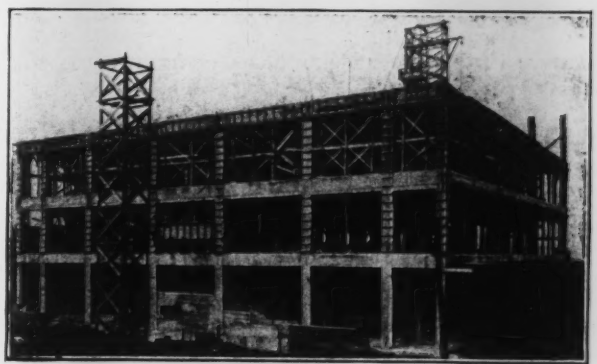
Deficit financiering will be abandoned by the City of St. Paul as a result of a charter amendment adopted May 7 by a vote of 23,251 to 9043, or 3874 more than the necessary 75% majority. Each year the tax levy will contain an item of 4% of the next preceding levy, to be invested in tax indebtedness certificates, principal and income to be kept intact to provide a fund to put the city on a cash basis. At any time the city council, by a four-sevenths vote, may issue 4% serial bonds running not longer than 20 years, in such an amount as, plus the tax levy certificates already bought, will equal the total outstanding tax levy indebtedness. This year's tax levy is $4,740,000. The certificates issued against it will be paid from 1919 taxes, at an interest expense of about $200,000. During the past 20 years $1,539,000 interest has been paid on tax indebtedness certificates. This and related facts were placed before the voters by advertisements in the daily press before the date of the election.

Main Beams in Concrete Garage Are Forty-Nine Feet Long

Turning Trucks Requires Floor Clear of Columns—Long Beams Designed as Continuous with Outside Panels Cantilevers

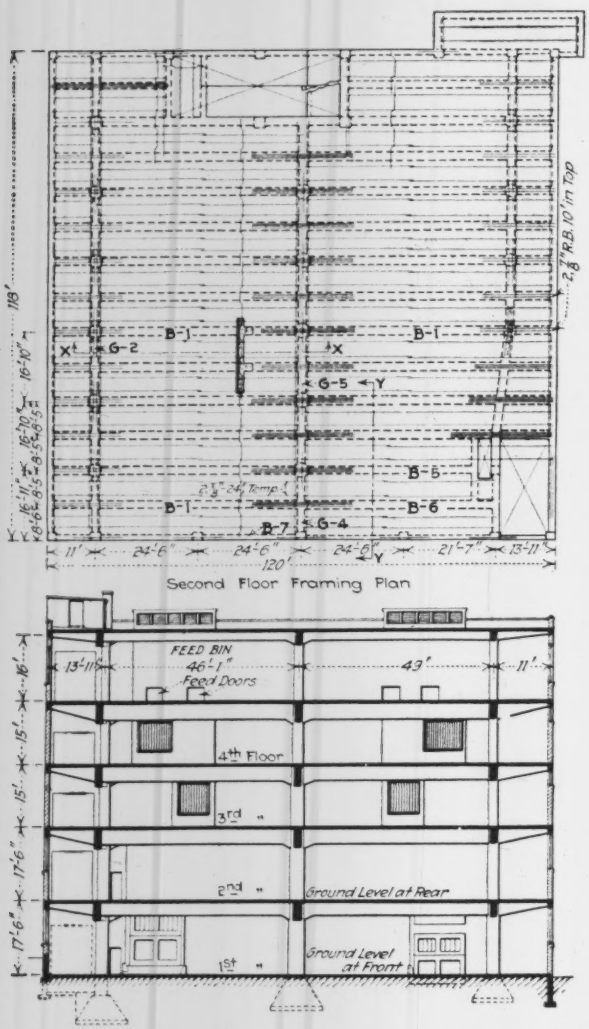
IN A combination stable and garage just erected in Pittsburgh, Penn., for the Edward E. Rieck Co., an extra large, unincumbered floor space was gained by the use of long span, reinforced-concrete girders with cantilevered beams supporting exterior walls. By this means the 120-ft. width of building was divided into two open spaces nearly 50 ft. wide, permitting the easy access of motor trucks to their storage places on the garage floors. In addition, the building is interesting on account of the heavy concrete fill used on the upper floors to provide the proper slope for the drainage on the stable floors.

The building is 120 x 118 ft. in plan and five stories high. It is on a side hill so that the ground level is at the first floor at the front and at the second floor at the rear. Excavation was made into a hard shale formation so that the first or ground floor rests upon natural rock. The first floor is to be used exclusively for the storage of automobile trucks, the second for wagons, the third and fourth for stabling horses, and the fifth for a machine, varnish and paint shop and miscellaneous storage. The height of the first story was practically fixed by the natural difference in grade between the front and rear streets at 17 ft. 6 in., giving a clearance from the floor line to the under side of the concrete beams of approximately 13 ft. This height is greater than is usually found in garage or wagon storage floors, but in this particular case it was found



FIVE-STORY REINFORCED-CONCRETE GARAGE AND STABLE UNDER CONSTRUCTION AT PITTSBURGH

necessary in order to accommodate the maximum size truck and still allow sufficient space for the plumbing, heating and sprinkler pipe lines hanging from the ceiling. The second floor has a 17 ft. 6 in. story height, and the third and fourth floors are 15 ft. from floor to floor level, and the top floor 16 ft. to the roof cornice. On the third and fourth floors are sufficient stalls for 254 horses and a fireproof runway of reinforced-concrete sloping slabs is provided for the horses in the rear of the building, beginning at the



STABLE AND GARAGE BUILDING HAS WIDE OPEN FLOOR AREA UNDER 49-FT. GIRDER SPANS

ground floor and continuing to the fourth floor with means of entrance and exit at all floors.

The 120-ft. width of the building is divided into two interior spans each 49 ft. long and two exterior cantilever spans 11 ft. from center line of columns to the outside wall. These columns are placed 16 ft. 10 in. on centers in the other direction and the beams are 8 ft. 5 in. c. to c. The long-span construction with cantilever beams and the omission of wall columns were adopted after several comparative designs of all sorts of ordinary construction had been made. It was found that the amount of steel and concrete per square foot floor space with the long-span construction was considerably less than the ordinary short-span design. This was one of the governing factors in selecting the long-span construction, but not the only one. The unusual size of the trucks to be accommodated and the freedom of movement within the building desired made it quite necessary to reduce the number of columns to a minimum. The distance between the inside face of the brick wall and the center line of the first row of columns is 9 ft. 11 in. This allows the front wheels of a truck to extend beyond the base of the column out under the 49-ft. span, which facilitates the handling of the trucks owing to the fact that they do not tend to strike the columns in being moved out from their storage space.

The reinforced-concrete columns are on prismatic footings of concrete placed in excavations in the shale formation. The first floor slab is 5 in. of monolithic concrete with a 1½-in. cement finish and laid directly on shale rock, smoothed off to give a fairly level surface. The different floors are generally similar in design and are detailed according to the typical designs shown in the accompanying drawing. For instance, in the second floor the main beams supporting the floor are 20 in. in width and 42 in. in depth from the top of the slab, and the span 49 ft. c. to c. of columns. The cantilever beams are of the same depth at the columns, but are decreased to 18 in. at the outside wall. The spandrel wall beams supporting the 13-in. brick curtain walls are 13 in. wide by 18 in. deep and are supported on the ends of the cantilever beams. The floor slab is 4½ in. thick and spans 8 ft. 5 in. c. to c. of beams. It is reinforced with ⅜-in. ribbed bars 6 in. c. to c. All of the reinforcement is either the ribbed bar or the Kahn bar manufactured by the Truscon Steel Company.

The beams are designed with a T-section and the width of flange was figured as 8 ft. 5 in., or one-half of the span of the slab on each side of the center line of the beam. This slab though shallow as compared to the depth of the beam has been figured as a T-section in compression owing to the amount and closeness of reinforcement running perpendicular to the main beam in the bottom of the slab. The main girders of the second floor, spanning a distance of 16 ft. 10 in., are 20 in. wide and 56 in. deep from the top of the slab. These girders support the concentrated load of the 49-ft. beams at the center.

All reinforced-concrete is designed in accordance with the rules and regulations of the Pittsburgh building

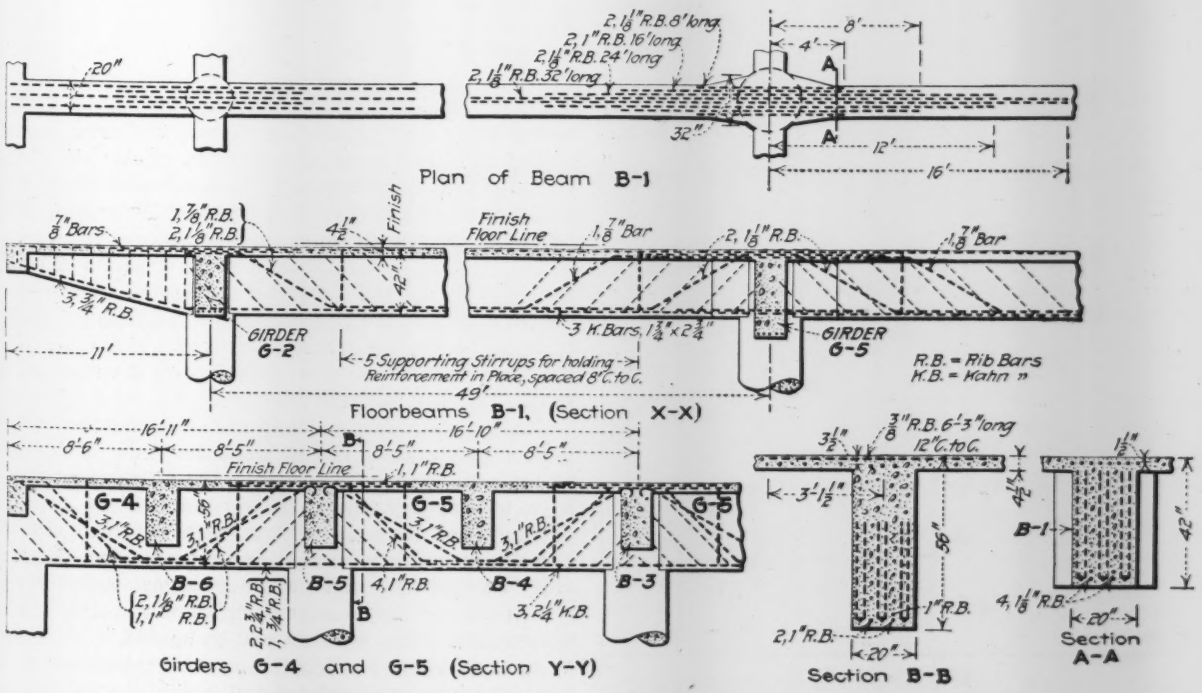
OUTSIDE WALLS CARRIED ON 11-FT. CANTILEVERS

LOOKING ALONG MIDDLE LINE OF COLUMNS; FORTY-NINE FOOT GIRDERS ON EITHER SIDE

code, but the long-span beams with cantilever ends were analyzed according to the theorem of three moments.

The live-loads used in the different floors are as follows: First floor, slab rests on ground and design load was required; second floor, 125 lb. per sq.ft.; third and fourth floors, 130 lb. per sq.ft.; fifth floor, 200 lb. per sq.ft.; roof, 40 lb. per sq.ft. In addition to these live-loads, there was a heavy dead-load due to the concrete fill and asphalt finish as described later in this article.

The finished floors of the two stables, the third and fourth floors of the building, are provided with a slope to take care of the drainage from the stalls. This slope is made up of a concrete fill placed on top of the structural slab. It has a minimum thickness of 2½ in. at the gutter and increases to a maximum of 5¾ in. at the head of the stalls. On top of it is a 1½-in. thickness of asphalt mastic. The average dead-load per square foot of floor as imposed by this concrete fill and the finish is figured at 80 lb. The gutters on these floors are of asphalt and the drains are placed at very close intervals leading to ground pipes through the floors that lead into pipes suspended from the ceiling below.



REINFORCEMENT DETAILS AND DESIGN OF LONG CONCRETE GIRDER

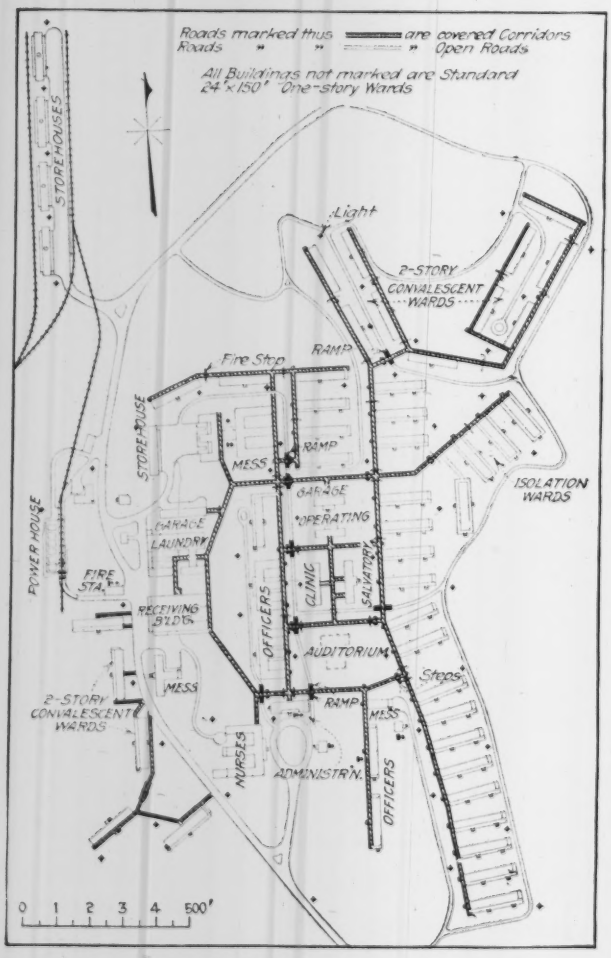
The finish used for the floors where trucks and wagons are stored was made of a top coat of 1½-in. thick cement mortar, a 1:2 mix, with Master Builders' hardener in the proportion of 40 lb. to every 100 sq.ft. of floor incorporated in the finish. The 1½-in. cement finish for the first floor was placed on top and integral with the 5-in. concrete slab resting on the rock. The finish for the second floor was on top of a concrete fill similar to that of the third and fourth floors, the thickness varying from 1¾ in. at the floor drains to 4¼ in. at the high points. The entire fifth floor has a 1½-in. cement finish that is bonded to the structural slab and placed perfectly level with no concrete intermediate fill.

The building was designed and supervised by the C. B. Cooley Co., architects and engineers, Pittsburgh, Penn., of which D. N. Martin is chief enginer, and was built by Toupet, Beil & Conley, contractors, also of Pittsburgh.

How Army Hospitals Are Being Protected Against Fire

Wood-Frame Buildings Are Mostly Used, But Smoke and Fire Stops Are Frequent, Exits Numerous And Fire Alarms and Fire-Fighting Apparatus General

HOSPITALS are a very necessary part of every army camp and cantonment today. More than that, they were among the first of the buildings that had to be completed in the early days of the war. Speed of construction was the controlling factor in their design, for they had to be ready to take patients as soon as troops were encamped. With this in mind, the engineers of the cantonment division existing then, selected, under instructions from the Surgeon General's office (which had the deciding voice in the matter of hospitals), wood-frame buildings for the cantonment hospitals. The buildings are of the same general type as that adopted for the barracks. Such buildings are now in use.



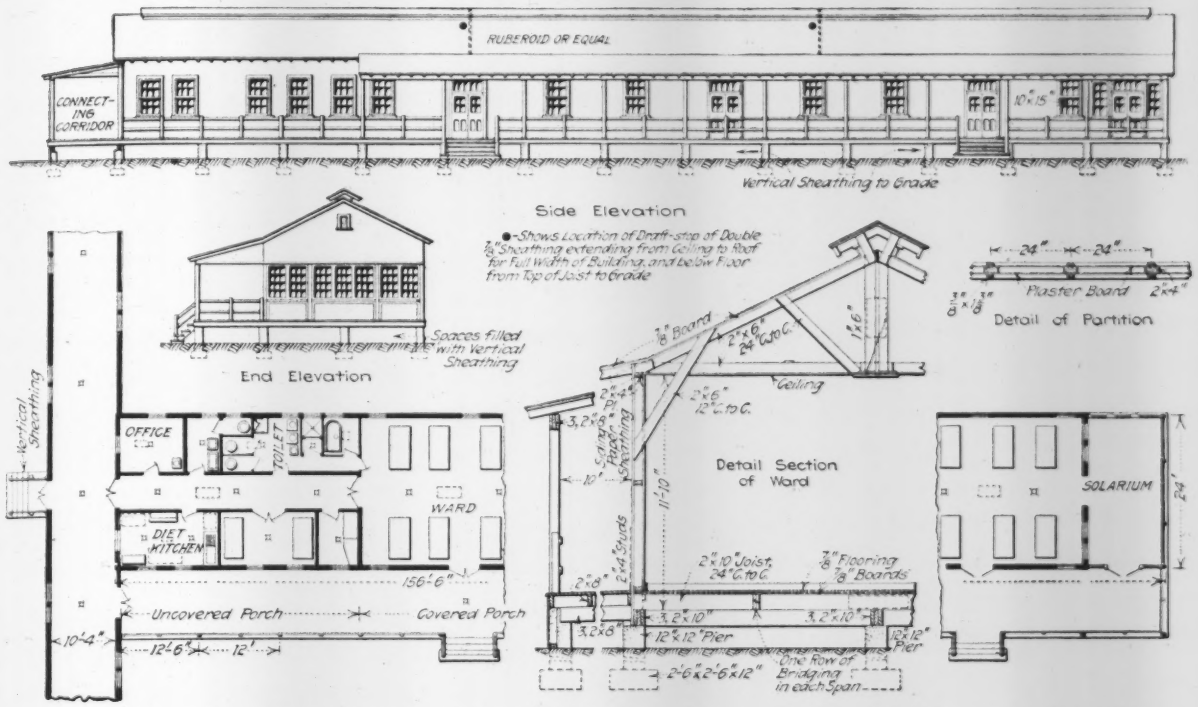
STATEN ISLAND HOSPITAL TYPICAL OF THE LAYOUT OF TOWNS WHERE SICK SOLDIERS ARE CARED FOR

When the first rush of construction was over, considerable attention was directed toward the fire-resisting qualities of the hospitals. Although they had protection equal to that of the other camp structures, they were criticised in some quarters for not being more fire-resistive, as would become buildings housing sick men who are more or less helpless. In view of this, steps were soon taken to improve the fire resistance of those hospitals already erected and to make certain changes in the design of the larger general hospitals which were to be erected mainly for the sick and wounded from overseas. The details of the changed designs and of the new hospitals are the subject of this article.

A drawing printed herewith shows the plan and layout of one of the general hospitals, and is typical in so far as the principles of design are concerned. This is the clearing hospital at Fox Hills, on Staten Island, in New York harbor. Provision is made for 1500 beds, together with the many appurtenant buildings. A railroad spur brings trains to a storehouse group at the lower end of the site, which is on country sufficiently well broken up to require bending of roads and arrangement of the buildings to fit the contours. From the storehouses, a switchback extends to the entrance of the hospital proper and to the power house which supplies heat and light. From the entrance roads extend to all parts of the grounds, so that each building or group of buildings can be reached by motor or wagon. The reader should note a distinction made on the drawing between these roads and the covered corridors which connect all the buildings, and over or under which the main roads pass. This will be described later.

The buildings in the group comprise the administration, nurses' and officers' units at the south middle part of the site, the receiving wards, the disinfecting buildings, the laundry, the mess and the kitchens near the entrance, the operating rooms, with the chambers for the clinics and laboratories about the center, the two-story convalescent wards at the extreme southwest and northeast, and the numerous standard one-story wards where most of the patients will be housed.

As a preliminary precaution against the spreading of fire, all buildings are placed well apart, the spacing de-

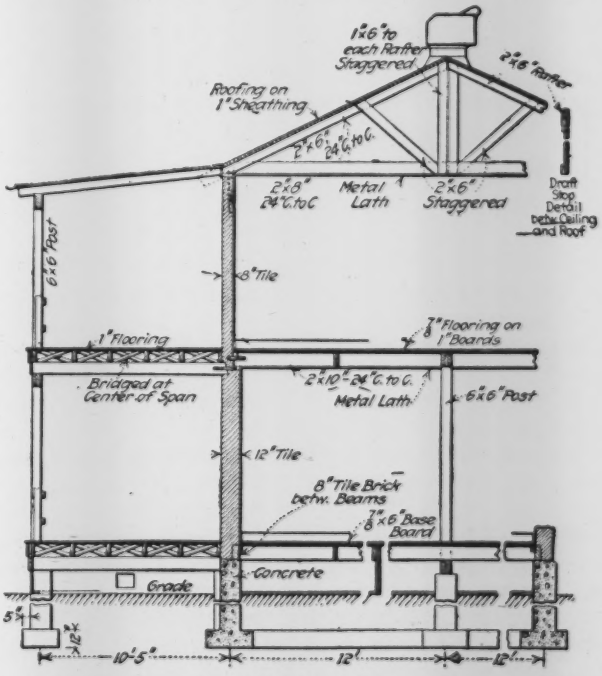


ONE-STORY WARD WHICH HOUSES 32 PATIENTS. WOOD FRAME WITH AMPLE EXITS AND FIRE STOPS

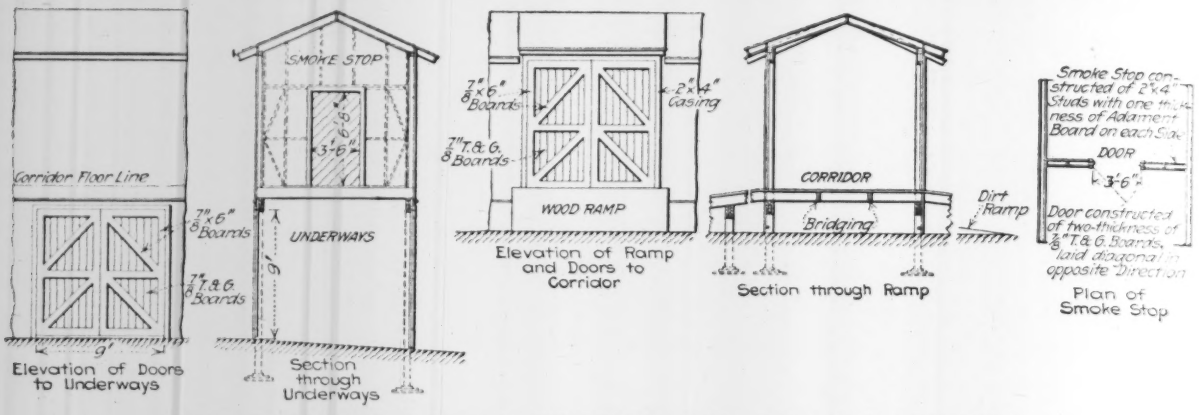
pending on the size, construction and use of the structures. Thus, one-story frame wards, barracks and similar buildings not over 40 ft. wide and 100 or more ft. long have a side-by-side spacing at least 50 ft. and an end-to-end spacing at least 35 ft. Two-story wards over 30 x 100 ft. in plans have side spacing of 80 ft. or more, and end spacing at least 50 ft. The storehouses are more than 100 ft. apart in each direction and the laundries and the garages are at least 80 ft. from other buildings. As shown on the plan, the wards are in groups with a minimum spacing of 150 ft. between the groups. It is considered that this spacing reduces to a reasonably safe minimum the danger of fire in any one building spreading to others or sweeping over any considerable portion of the hospital area. In six months' experience with the cantonments, where such spacings have prevailed generally, there have only been three serious fires, and in each case the flames were confined to the building in which they originated.

One of the drawings herewith shows the details of the one-story wards which make up the bulk of the hospital and in which the seriously ill or wounded will be housed. It is a frame building, 156 ft. long and 24 ft. wide, with a porch, partly open and partly covered, on one of the sides. Studs of 2 x 4's sheathed on both sides with paper and board siding carry light wood trusses with standard composition roofing on 1-in. boards. At one end of the building is a glass-walled solarium and at the other end a partitioned section for the service rooms. Between is the open ward, with space for 32 beds. The numerous windows are plain-glazed and four wide doors open on the porch and two on the corridor. Connecting with the porch and with the building itself is the covered corridor, which is inclosed for most of its length and which forms a continuous closed connection between all of the buildings on the site.

As a protection against fire in this ward building, the partitions are of plaster board, the ceilings are of the same material, the attic space is subdivided by continuous stops, the under floor space is continuously sheathed from ground to floor, and there are intermediate fire stops across the building below the floor.



TWO-STORY WARDS ARE NOW BEING BUILT WITH HOLLOW-TILE WALLS



SOME OF THE CHANGES MADE IN OLD HOSPITALS TO REDUCE THE FIRE HAZARD

A detail of the fire stop in the attic and under the floor is shown on the drawing of the two-story ward, to be described later in this article. In addition, fire-resisting paint is specified where painting is required. All the lighting and heating pipes and wires are carefully insulated at all points of contact with the wood. Also the doors are numerous enough and of such width as to permit the ready removal of all patients in their beds to the porch in a short time and the porches are so near the ground as to make easy the carrying of the beds to the open air.

The corridors are all of frame construction, similar to that of the building. Connecting, as they do, adjacent buildings, they offer the easiest means for the spread of fire. In completed hospitals the hazard has been reduced by the interposition of a number of draft stops of plaster board or block, with fire-resistant doors, which are kept closed or are provided with automatic self-closing devices.

In the newer types of construction hollow tile walls have been substituted for the wood frame. Wards for convalescents are two-story buildings. At first these were of wood frame, similar in design to that of the one-story ward. In the later design, however, the hollow-tile construction shown in one of the drawings has been substituted. As an additional precaution, in such buildings there are two wide stairways leading down from the upper porch and one interior stairway completely inclosed in hollow-tile partitions. These buildings have the same protection as the smaller ones in the matter of fire and draft stops, doors, paint, etc.

A complete fire-alarm system covers the whole site. This consists of automatic thermostatic alarms connected to the fire station and to administrative centers, and so arranged as to detect and locate any unwarranted rise in temperature.

As will be noticed from the plan of the Fox Hills hospital, the corridors cut off pretty thoroughly a large part of the interior of the site. To make all parts of all buildings accessible to the fire-fighting apparatus, the corridors are cut at proper places and the main roads are passed either over or under the corridor. At such places a rising or declining ramp leads the road either up to or under the corridor level, and the crossing is provided with a door, normally closed, but capable of being opened wide enough to permit the passage of the fire engine. At such crossings the spaces under the corridor are boarded off as fire stops.

In such of the older hospitals as had been completed without the taking of the precautionary measures noted above, protection against fire was later increased by certain structural measures. Some of these are shown on one of the accompanying drawings. Smoke stops, generally 150 ft. apart and separating not less than two buildings, were placed across corridors. Draft stops were built at underways, additional doors were cut to the porches, extra steps were added, lights and signs were provided and complete fire alarm systems installed. Ramps or underways affording entrance to interior spaces were put in where required. All of these additions, together with the painting of the composition board partitions with fire-resisting paint, were intended to make the old structures as nearly like the new as possible, without complete change of structure.

In one new hospital, that for tubercular patients at Denver, Colo., two-story hollow-tile buildings of special design were used. This was done because of the difficulty of getting wood in that district. In the opinion of the Surgeon General this hospital is of a more permanent nature due to the fact that the patients there are apt to be confined for a long period and because in providing this hospital there was not the urgent need for speed there was in getting ready the hospitals for the sick soldiers at camps or for the wounded from overseas.

The basic requirements for the hospitals were laid down by the surgeon general's office, United States Army, and that office has final supervision of the details. Those details were designed in the cantonment division, quartermaster department, now the construction division of the army, and the buildings were put up under the direction of the officers of that division. Engineers of the National Board of Fire Underwriters acted in an advisory capacity with regard to fire-protection and water-supply operations.

Meters Show Low Water Consumption

With 79.5% of the water services and 45.6% of the pumpage metered, the average daily water consumption of Dover, N. H., in 1917, was 46.8 gal. per inhabitant, 46.9 per consumer and 325 per tap. The population, by the census of 1910, was 13,247. H. E. Perry is superintendent of water-works.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Claverack Bridge Failure Caused By Subsidence or Scour?

Sir—In *Engineering News-Record* of Mar. 28, p. 619, in describing the failure of a bridge at Hudson, N. Y., I stated that the failure was due to a subsidence of the ground under one of the piers.

In the issue of Apr. 18, p. 786, Edward Godfrey states that the failure was due to bad design. Mr. Godfrey's conclusion is not convincing, possibly because of brevity. It would be of interest to know just what defects could have led to failure, outside of foundation trouble.

E. L. Brandow in the issue of Apr. 25, p. 830, ascribes the failure to scour. The facts as presented by Mr. Brandow can lead to but one logical conclusion; that the failure was due to a subsidence of the gravel formation, and to no other cause.

The gravel formation at the site of the failed bridge is of unusual nature and very closely resembles an ice pack in a river. The cakes of gravel are jammed on edge, the interstices between the cakes of gravel being filled with sticky clay which becomes soft when saturated with water. The top of the gravel formation is weathered, and its exact nature could only be determined by making test pits, or possibly by driving piles.

The gravel under the pier which failed had a thickness of at least 15 ft.; its thickness at the opposite end of the bridge, which portion is still standing, is about 5 ft., but the gravel cakes lie more level at the latter point. Some of the piles under the failed pier refused at less than 15 ft. penetration under a 2000-lb. hammer falling 20 ft. Other piles at the same location sank under the weight of the hammer alone, due to the fact that they entered interstices between the gravel cakes.

The effect of loading such a formation would be exactly parallel to that produced by placing a heavy load on an ice pack, where as soon as the cakes thawed apart the loaded portion would slide into the water and of course the water would fill the space which had formerly been occupied by ice.

Briefly, Mr. Brandow states that after the failure had occurred soundings were made about the bridge with a pole, and it was found that there was a hole at the point where the failed pier had been, that the bottom of the hole was at a lower elevation than the base of the pier and was in soft clay which offered little resistance to the thrust of the pole. In view of this condition, could the failure have been due to scour? Obviously not, for, as has been stated, the gravel had a thickness of at least 15 ft. at this point. On the other hand, a subsidence of the gravel formation would have left exactly the condition described by Mr. Brandow.

Furthermore, Mr. Brandow states that the gravel at adjacent piers was found to be well above their bases. As is shown by the illustrations which accompanied Mr. Brandow's article, exactly the same scouring conditions prevailed at the adjacent piers as at the failed pier. In view of this, why did such heavy scour take place at one pier when there was no scour at the adjacent pier, less than 30 ft. away? The answer is that it was not scour but subsidence, such as I have described.

I can readily agree with Mr. Godfrey that the design was defective, in the sense that it was not suitable for the location. Further, it may be considered defective as regards economy, but I am certain that failure did not come through any defect of the structure itself. It had been tested far in excess of its design load.

Mr. Brandow puts the responsibility on the maintenance man, but in this case he was not at fault. The responsibility lies with the designer, who was satisfied with superficial data and did not take the trouble to make borings. It is another case of town boards squeezing a penny, and so long as engineers are willing to base their designs on hearsay data we can expect just such occurrences.

Albany, N. Y. E. J. DOYLE.

Pavements and Frost Action

Sir—I have read the editorial in your Apr. 11 issue entitled, "What Most Highway Departments Will Face in the Near Future."

In the first sentence you display some misgivings as to the effect of frost on many concrete and brick pavements over which heavy loads must be transported. I have yet to see a concrete road which was rendered unusable because of frost action. In a very few roads there has been some heaving at the joints, probably due to the fact that the joints were not placed perpendicular to the surface of the road. This condition, however, has not rendered the roads unusable, as temporary repairs with tar and sand at these uneven joints have prevented excessive wear, and later on slabs have in most cases settled to their original position. I have read of a few brick pavements which do not seem to be holding up under heavy traffic. Even these cases, it would seem, may very properly be attributed to improper design—failure to provide a sufficiently heavy foundation of concrete to carry the excessive loads to which the pavement was subjected.

If you had said "and a few concrete and brick pavements," instead of "and many concrete and brick pavements," there would be no argument, as we shall always have a few poorly constructed pavements of the more durable type. As the first sentence of your editorial now reads, it seems to me it is incorrect.

W. M. KINNEY,
Engineer, Promotion Bureau, Universal Portland Cement Co.
Chicago.

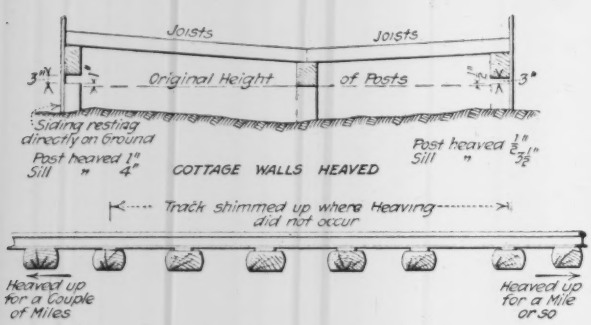
[Support to the statement objected to seems to be given by an illustrated article in the May 1 issue of the *Commercial Vehicle*. The article describes the poor condition of the 40-mile road from Cleveland to Akron, Ohio, during February, March and April of this year. "There were one dozen more of these points," it is said,

"where the entire brick surface had swollen up and broken apart, leaving jagged holes composed of broken bricks and large slabs of the 4-in. concrete base which acted as a foundation for the road." And some of the illustrations indicate that the author of the article did not exaggerate.—Editor.]

Water Expansion in Ground Cause of Heaving in Winter

Sir:—Some special cases of the heaving of soil and structures due to freezing may interest those who have read Professor Taber's article on ice formation in *Engineering News-Record*, Feb. 7, p. 262, and the subsequent discussions.

In Sudbury, Ont., though it is further south than the northern parts of Montana and North Dakota, the cold is both more continuous and of an average lower temperature. A map of isotherms will show practically the same temperature for Sudbury and White River as for the Yukon District and Alaska. The ground starts to freeze here about the middle of November and keeps



EXAMPLES OF HEAVING FROM FREEZING IN ONTARIO

on freezing until the middle of March. There may be occasional warm spells when the thermometer will register 32° or 33° F., but they have no effect on the continued freezing of the ground.

In all parts of Canada it is necessary to provide against frost action whether the soil be sand, loam or clay, but in the towns of Sudbury and Copper Cliff special precautions must be taken on account of the peculiar soil. This soil is of the nature of a soft shale in summer, being so dense that it is not possible to drive a stake into it without displacing some of the soil. It was deposited in layers varying from $\frac{1}{8}$ in. to 1 in., the different layers being separated by very minute spaces which hold water by capillary attraction, and it is the expansion of the water that causes the ground to heave.

In Northern Ontario the ground freezes to an average depth of 4 ft.; less when the ground is covered with snow or muskeg, and more when the ground is bare and damp. The extreme frost action takes place toward the end of February, when the heaving of posts, houses, verandas and railway tracks shows in a marked manner.

In the southern parts of Ontario, the section man places shims under the track to provide run-offs at each end of the sections where the frost has heaved the track. In this district he places shims in those spots where the track *has not heaved*, as shown in the drawing, for the track rises bodily for miles. In yards where earth is used for ballast, the heaving is of course much greater, and it is plainly seen that the earth rises first between the ties and later the tie rises and the track assumes an appearance of perfect grade.

Another sketch shows how the walls of a cottage were heaved up, leaving the center at the original level so that the roof moved, cracking the chimney. The house was set afire. This started an investigation which revealed conditions shown in the sketch. The walls were sheathed to the ground, and the upward movement of the earth had forced the sills off the posts, although these had also risen an inch or so by the gripping of the clay. There was no ice between the sheathing and the ground, which was noted particularly, as levels were taken to ascertain the extent of the heaving. The center post being protected from the frost, had not heaved.

In addition to the direct heaving, this clay is so sticky and possesses such great cohesive properties that it will force up posts and walls by the adhesion of the frozen clay. Telephone posts are heaved in such a manner, and the only remedy is to place clean gravel or granulated slag around a post, as these possess no cohesive properties whatever. Walls of stone cellars are sometimes parted into two by a similar force.

These cases may be extreme, but they seem to demonstrate that the ground heaves or rises in the winter because the water in the soil expands and not, as Prof. Taber suggests, by the formation of ice crystals on the surface.

Sudbury, Ont. C. D. NORTON.

Drain Tile Price Increases and Problems

The rapid increase in the price of drain tile will have considerable effect on drainage projects during the next year or two, according to a report of the drainage committee of the Minnesota Surveyors' and Engineers' Society. Increases from 1913 to 1917 per 1000 ft. of tile in carload lots for the central southern part of Minnesota were as follows: 6-in. $35.50 to $47; 8-in., $57 to $75; 10-in., $96 to $125; 12-in., $116 to $160. There is nothing to indicate that the top price has yet been reached, and transportation difficulties make it increasingly harder to get the tile. The committee also called attention to the great dissatisfaction among land owners with the present method of assessing benefits and damages. These assessments are made by three viewers, who it is assumed can classify the land according to its comparative wetness. The engineer is not allowed to be present when the viewers fix the amount of benefits and damages. It is quite apparent that making a just and equitable division of benefits and damages requires experience, with a logical and mathematical mind capable of giving proper values to many factors and conditions. That the viewers have made a hopeless mess of things under the present system is evidenced by the great number of appeals against assessments on recent drainage work. The committee recommended that in every case two of the viewers be engineers, even if this means increasing the number of viewers to four.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

New Train Arrangement Enables Tractor To Start Heavier Loads

PROPER placing of the tractor with respect to its train will, it is said, greatly increase the load which it can start. It is self-evident that the load which any hauling device can start from rest determines the amount that can be handled by it, and therefore this new method should add to efficiency.

The new arrangement of train was worked out on a contract where it became necessary to increase the load on account of the labor shortage. It was found that there was great trouble in starting, especially where the ground was soft, but when the load was once in motion the tractor had no trouble in handling it even on worse ground. Experimentation followed and developed the fact that placing the tractor at right angles to the loaded train instead of in the direct line of loading made it possible to start greatly increased loads with ease.

The reason is easily stated. The new arrangement applies the old principle of gradual application of the load until the full train is in motion. Each trailer is first turned and then started largely by the momentum of the preceding portion of the train.

YOUR TWO GREAT PROBLEMS—MATERIALS AND MEN

War has profoundly upset working conditions for the contractor. No one needs remind you of your two most pressing problems of the moment—materials and men.

Have you succeeded in solving either of them in special ways?

Have you made material at hand do for material you needed and could not get?

Have you rigged up good substitutes for plant that is no longer on the market?

Have you managed to do with eight men work that used to take ten?

Have you learned new ways to keep men on the job?

Help the other fellow—help our national efficiency—tell about it in

HINTS FOR THE CONTRACTOR

Laying Eighteen-Inch Drain Pipe Below the Water Table

A DRAINAGE problem in the South San Joaquin Irrigation District in California has been solved by laying an 18-in. pipe line with the aid of wooden cradles, and cementing only the top half of the joints. The problem arose from the fact that the line had to be laid in very soft ground below the water table, and it was found impossible to maintain the correct grade, if single lengths of pipe were placed independently. Accordingly, wooden cradles, as shown in the photograph, were made of 1 x 4-in. runners with two cross-ties for each section of pipe. These cradles, which were long enough to carry four lengths of pipe, and make sills or other supports unnecessary, were placed carefully to grade.

Vitrified sewer pipe was used instead of the ordinary drain tile, and special attention was given to making the joints in such a way that entrance of silt was prevented. When the pipes were in place on the cradles small box forms were set around the lower half of the joints, and these forms were filled with gravel. After the gravel was placed, the trench was filled up to about the same level as the tops of the forms, which were then carefully removed. The top half of the joint was then cemented in the ordinary manner and the gravel filling was raised to cover the lower two-thirds. This provided a lap between the gravel and the cement joint.

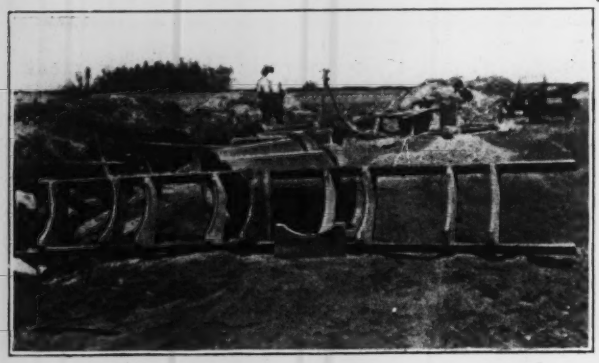
One of the illustrations shows the pipe in place in the trench, with a workman, seen in the background, cementing the tops of the joints. The gravel at each joint will be noted in the partial fill, the gravel forms having already been removed. In the foreground of the illustration, the gravel is being put in place around the lower parts of the joints in a new section of the pipe line.

The careful attention to the joints was necessitated by the fact that a great deal of quicksand was encountered along the line and it was necessary to keep this out of the pipe line. The quicksand, of course, added to the cost of the work and the construction difficulties. On one occasion a laborer was caught in the quicksand and had to be lifted out with a chain block, leaving his boots embedded. The plan of construction was to keep the pipe-laying close behind the dragline excavator, and to

CEMENTING AND PLACING GRAVEL AROUND THE JOINTS OF EIGHTEEN-INCH PIPE

have the trench back-filled as soon as possible. This prevented excessive flow of water into the trench.

About 4000 ft. of 18-in. pipe and 1000 ft. of 12-in. pipe were laid in this manner, and though the lines have now



FORM OF CRADLE USED IN LAYING EIGHTEEN-INCH PIPE IN QUICKSAND

been down about a year, no trouble from silting up has developed.

The work was done under the supervision of A. Griffin, chief engineer for the district, who has since been succeeded by R. W. Olmsted.

Concrete Cradles for Long Pipe Line Require Three Mixer Plants

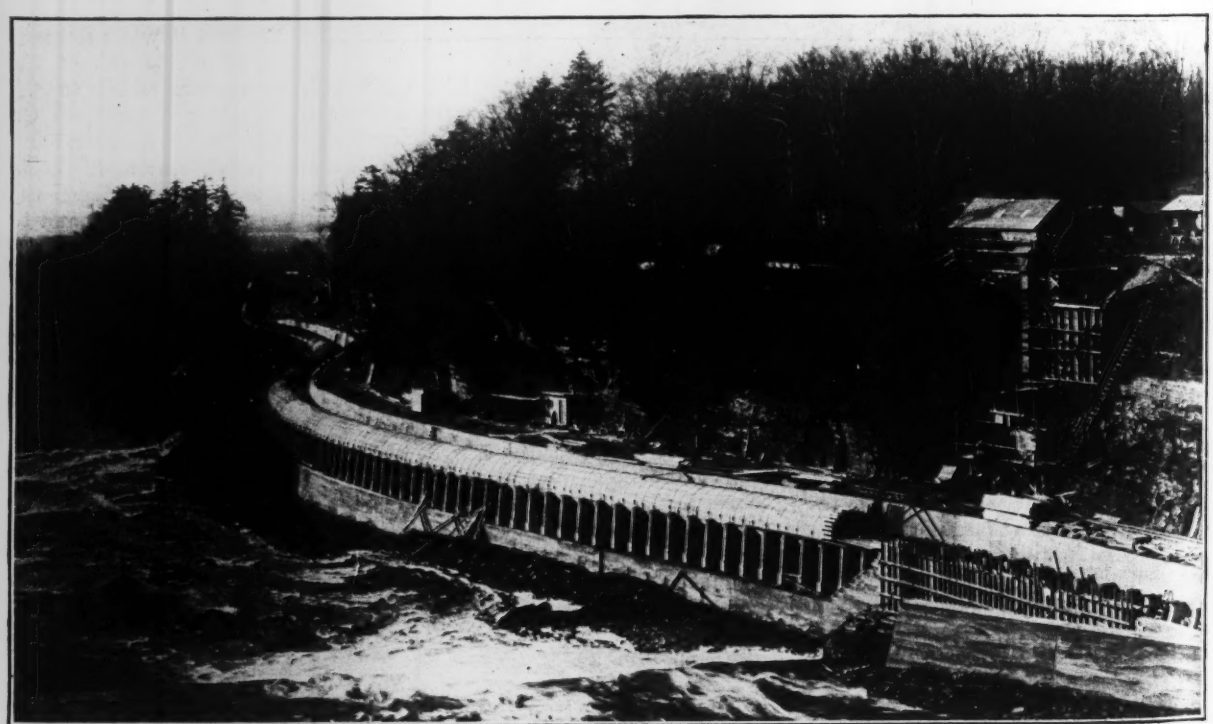
IN BUILDING the 3500-ft. pipe line leading from the dam to the power house of the Trenton Falls power development described on p. 1028 of this issue, three complete concrete mixer plants were used, two along the pipe line and one at the power house. The new line consists of 2680 ft. of 12-ft. wood-stave pipe and 800 ft. of riveted steel pipe of the same diameter, the whole line being supported on concrete cradles on 7-ft. centers. Along the line also runs a protecting wall of concrete, to guard against slips of earth.

All three plants were constructed so that the sand and stone bins and cement sheds were above the mixers, and the material was fed by gravity into the mixers, which for the two plants along the line were set high enough to discharge by gravity into side-dump, dinky-drawn narrow-gage cars running on tracks located over the old pipe line, which parallels the new. The concrete for practically all of this work was chuted from the cars into the forms. The upper of the two pipe-line mixers was operated by an electric motor, while the lower was operated by an air compressor, compressed air being supplied the entire length of the job. The power house plant is built as were the others, except that from this mixer most of the concrete for the power house itself was placed in buckets handled by derricks.

Cutting Up Granite for Paving Blocks

Around the old city hall in San Francisco there was a low but massive granite wall whose removal was something of a problem when the site was being reclaimed. There was no market for the large pieces of granite, and it would have cost approximately $2000 to haul them away to the dump.

A solution of the problem was found which disposed of the granite and provided the city with 75,000 excellent granite paving blocks at $37.50 per thousand. It was found that for this figure the granite could be worked up readily into blocks about 6 in. deep, 7 to 8 in. long and 3 to 4½ in. wide. The work of cutting up the granite was done entirely by hand by men who were paid $6 per day.



CONCRETE FOR PIPE LINE DELIVERED ALONG NARROW GAGE RAILWAY FROM HILLSIDE MIXING PLANT

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

McAdoo Orders Sweeping Railroad Changes

Presidents Deposed, Wage Increases Approved and Rates Raised 25 Per Cent.

The past week has witnessed the most sweeping railroad changes since the Government took charge of the railroads last December. The presidents of all railroads under the jurisdiction of the Director General were removed from office by a general order; the wage increases recommended by the Railroad Wage Commission, involving increased annual expenses estimated at more than $300,000,000, were approved substantially as presented, and to offset this and other added costs of railroad operations advances of about 25% in both freight and passenger rates are ordered, effective next month.

The rate increases are much more extensive than any ever sought by the railroads under private management. It is estimated that they will increase annual earnings $860,000,000. They nullify all conflicting intrastate rates. With the exception of commutation fares, which will be increased 10%, all passenger fares will be raised to a minimum of 3c. per mile, while the freight increases will cover all classes of commodities.

The wage increases ordered are substantially those previously outlined in this journal, providing a sliding scale of increases over 1915 figures—increases that reach a maximum of $34 per month for employees receiving $85 per month, and tapering to nothing for salaries of $250 or more per month. The basic eight-hour day is indorsed, as is the principle of equal pay for equal work, irrespective of race or sex.

To aid in the adjustment of possible inequalities, a board of six members, called the Board of Railroad Wages and Working Conditions, is created. It is composed of three labor representatives and three railway executives. These are the men named: J. J. Dermody, vice-president of the Order of Railway Telegraphers; G. M. Sines, vice-president of the Brotherhood of Railway Trainmen; A. O. Wharton, head of the railway employees' department, American Federation of Labor; F. F. Gaines, superintendent of motive power, Central of Georgia Ry.; C. E. Lindsay, division engineer, New York Central R.R., and W. E. Morse, general manager, Denver & Salt Lake Railroad.

The removal from office of the railroad presidents is understood to have been made to eliminate the dual and conflicting responsibility of these officials to the administration and to the stockholders of the companies. In their place will be appointed Federal managers, who will be accountable only to the regional directors. It is believed that in many cases the deposed presidents will be reappointed Federal managers.

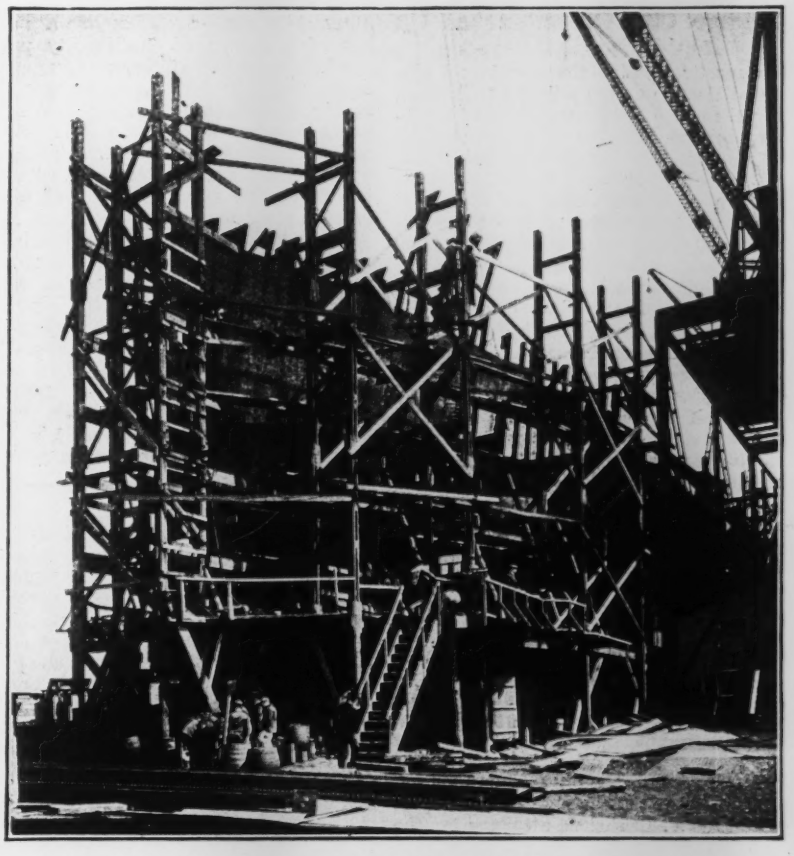
Two new regions have been formed in the East. The Pennsylvania and Baltimore & Ohio systems east of Pittsburgh, together with the Central R.R. of New Jersey, Philadelphia & Reading, Western Maryland, Bessemer & Lake Erie, Pittsburgh & Lake Erie and other roads in the district, are included in the new Allegheny region, which will be directed by C. H. Markham, transferred from the Southern region. The new Pocahontas region embraces the Chesapeake & Ohio, Norfolk & Western and Virginian systems. N. D. Maher, late president of the Norfolk

Launching of First Steel Ship by an Agency Shipyard

The Newark Bay shipyard of the Submarine Boat Corporation will launch the 5500-ton steel freighter "Agawam" on May 30. This is the first vessel to be launched at one of the agency yards of the Emergency Fleet Corporation. The keel of the "Agawam" was laid in December, and since the clearing up of railway conditions and the receipt of adequate quantities of steel progress on the ship has been rapid. The picture reproduced herewith shows its condition on Apr. 26. At the present time the 27 other ways of the Newark Bay yard are all occupied, and erection is keeping pace with the arrival of fabricated parts from the outside shops.

The "Agawam" is a fabricated ship, its parts being punched and riveted in bridge shops and shipped to the yard for assembly. The vessel was designed by the naval architects of the Shipping Board as to general outline and by the designing department of the corporation as to details. Its dimensions are:

Length over all, 335½ ft. Length between perpendiculars, 324 ft. Molded breadth, 46 ft. Molded depth, 28½ ft. Loaded draft, 22½ ft. Dead-weight carrying capacity, gross tons, 5500.



STEAMSHIP "AGAWAM" ON THE WAYS AT NEWARK BAY ON APRIL 26

& Western Ry., has been made director of this region. B. L. Winchell, recently director of traffic of the Union Pacific system, has been appointed director of the Southern region, succeeding C. H. Markham. A. H. Smith and R. H. Aishton remain in charge, respectively, of the Eastern and Western regions.

Of the five regional directors, three—Messrs. Smith, Maher and Aishton—are former operating officials, and two—Messrs. Markham and Winchell—were traffic men. Mr. Aishton is an engineer, and rose to division engineer before being made division superintendent.

Chicago City Council Takes Up Rapid Transit Problem

Consolidation of the street and elevated electric railway lines of Chicago, together with the construction of a subway system, is being considered by the city authorities and the companies as a means of relieving the present congestion of street traffic and the complaints of inadequate service on the surface and elevated lines. The former numerous street railway companies have been consolidated and merged until one company now controls the entire system, giving a ride for a single fare and issuing transfers. The elevated railways have had the same history. The present demand is for a merger of both companies into one "unified" system, so that more adequate facilities may be provided, coupled with a universal single fare plus a small charge for transfers. The proposed subway lines are to relieve the traffic congestion in the downtown district and to expedite the long-haul service.

A single corporation operating under an indeterminate or terminable franchise, with provision for future purchase by the city, is the principal feature of a plan proposed some time ago by the Chicago Subway Commission. The companies agree in general upon this plan, but they desire a 30-year franchise, with no requirement for street paving or cleaning. A municipal-ownership or trustee plan has been proposed by W. L. Fisher, attorney for the local transportation committee of the city council. By it all the lines would be taken over and operated by a corporation having only a nominal capital and composed of leading citizens acting as trustees for the city. This committee, however, has instructed the attorney to draft an ordnance, including a provision for a 30-year franchise, based upon the general recommendations of the subway commission.

Legislation necessary for the merger of the present surface and elevated railway companies was approved by the city council in May, 1917, and was passed by the state Senate in June, but the House declined to pass it, owing to lack of a definite plan for submission to a referendum of the voters of the city. It is now hoped to secure agreement upon such an ordinance so that it can be submitted for vote in November and presented to the legislature in 1919. The board of supervising engineers, in charge of all city traction affairs, approves the 30-year franchise plan as meeting economic conditions best, while modern control by public utility commissions eliminates many former objections to franchises. It is proposed to relieve the companies from all work of street paving and cleaning on the ground that these requirements as now existing are based on the conditions of horse car days, and are not now proper functions to be imposed on local transportation companies.

University of Pittsburgh Has Gas Engine Course

Drafted Men Being Trained by Garage Experts Under Faculty Repairing Cars for Pittsburgh Owners

The technical training in gas engine work, organized for drafted men at the University of Pittsburgh, has proved highly successful, according to a recent statement authorized by the War Department. It is now taking care of 650 men and will be able to accommodate 2000 before the end of the summer.

The work at this university was confined to the training of gas engine and automobile men—first, because a number of members of the faculty were specialists in gas engines; second, because the city has many automobile repair shops from which practical men could be taken to give the instruction; and third, because the city offered an opportunity for obtaining without transportation a large variety of worn and broken automobiles.

The problem of instruction has been met by collecting about 45 of the best automobile repair men in the city who, under the leadership and coaching of faculty members, have taught with success. It is continually impressed upon the instructors that the work they are doing is very important, that if one-fourth of the men they train prove to be poor mechanics the result is just as serious as or probably more serious than if one-fourth of the shells made in a munitions plant should fail to explode.

New trucks and engines from the government, old and dilapidated cars which have been purchased outright by the university, and cars and trucks in need of repairs obtained from firms and individual owners, are used in giving instruction. Owners of cars pay for new material, but no charge is made for labor. The owner is allowed to choose whether he will have his car put in "first class," "fair" or "running" condition, with a corresponding range in the expense for new material. The university has provided shop equipment and individual tool kits for each student.

The university first met the housing problem by making use of the armory, gymnasiums and other buildings which could be temporarily adapted for sleeping purposes and for the feeding of the men. Barracks now are being built which by Aug. 1 will accommodate 2000 men. Shops have been built for 580 men, and these are being extended. A mess hall seating 1200 will be completed by June 15.

The whole character of the teaching is practical. No more instruction in theory is given than is absolutely necessary. It has been found possible to maintain the most intimate connection between the military and the mechanical aspects of the work. According to their officers, the men learn the routine of drill nearly as fast as they would if they gave their whole time to it.

Construction of Alaskan Railway Delayed by War

While the Alaska railway system undertaken by the United States Government is about 65% completed, work on the remaining portion will be delayed materially by war conditions, according to a statement made by William C. Edes, chairman of the Alaskan Engineering Commission. Scarcity of labor is one difficulty encountered. Last year the Commission had about 6000 men in the field; it is estimated that not more than 2600 men can be had this year. Work for 1918 will be concentrated on the completion of the line between Seward and Anchorage, and in laying rails for 50 miles on the line toward Fairbanks. This latter will bring the end of the track to 265 miles beyond Seward. Present cost of the work amounts to $23,670,000. The original estimate for the entire work was $35,000,000, but this has been raised to $40,000,000 by the increased cost of labor and materials.

Canadian Government to Control Dominion Railways

Sir Robert L. Borden, premier of Canada, announced in the House of Commons at Ottawa on May 15 that the Government is negotiating for the acquisition of the Grand Trunk and Grand Trunk Pacific Rys., and that at some future date all the railways of Canada would be carried on under one management, so far as operation is concerned. The Government, as soon as the award is made by the arbitrators fixing the value of the stock of the Canadian Northern Ry., will appoint a new board of directors for the railway of which neither Sir William Mackenzie nor Sir Donald Mann will be members, and the administration of the road would be left entirely in the hands of the directors free from any political interference.

The total liabilities taken over by the Government in connection with the Canadian Northern Ry. were $438,264,377, and the assets taken over amounted to $528,437,885. The capitalization of the Canadian Northern as taken over works out at approximately $43,000 per mile for 10,000 miles of railway in actual operation. The Grand Trunk Pacific is capitalized at practically $100,000 per mile and the National Transcontinental at approximately $110,000 per mile. Sir Robert stated that he had some reasonable hope that at the next session of Parliament he would be able to place before them proposals involving the constitution into one system of state-

owned railways in Canada of the chief railways of the country, with the exception of the Canadian Pacific, and that it was probable that at some later date all the railways, so far at least as operation is concerned might be amalgamated into one system.

The Hon. Dr. Reid, minister of railways, stated in Parliament May 17 that the result of the operation of the Canadian Government railways for the fiscal year 1917-18 was a deficit of $5.294,280. While the government lines had received a fair share of the business, the results had not been so good as anticipated on account of a substantial increase in the cost of maintenance and operation, but the results were fairly satisfactory as compared with those obtained by other lines. Working expenses totaled $32,298,000 while earnings amounted to $27,000,000.

Highway Materials Put on Favored List for Car Distribution

Highway materials are placed next to coal, coke and ore, on the preferential list for car supply, by the car service section of the railroad administration. This ruling applies particularly to stone, sand and gravel for maintenance and essential road construction. The aim is to assure the proper care of roads already built, and the construction of those necessary for the carrying on of the war. The regulations issued are as follows:

1. Open top cars, suitable for such traffic, should be furnished preferentially for the transportation of coal, coke and ore.

2. Available open top cars, not suitable for the transportation of coal, coke ore ore, may be furnished for the transportation of stone, sand and gravel, and when so furnished shall be used preferentially for highway maintenance materials.

3. Open top cars, suitable for the transportation of coal, coke and ore, and available on coal, coke or ore producing roads in excess of the demand of such commodities, may be furnished for the transportation of stone, sand and gravel, and when so furnished shall be used preferentially for highway maintenance materials. The return movement to mines or ovens should be utilized whereever practicable in furnishing car supply for stone, sand and gravel. Every endeavor should be made, consistent with keeping up the production of coal, coke and ore, to furnish shippers of stone, sand and gravel with a minimum of forty per cent of their normal weekly transportation requirements.

4. Roads which are not producers of coal, coke or ore must not use foreign open top equipment for stone, sand or gravel shipments, except for one load in the course of the return movement to mines or ovens.

5. Where the transportation needs of essential road construction or maintenance projects cannot be met by car supply furnished in accordance with the above rules, the state, county or municipal officials in charge of the work, should, through their proper state highway department, apply to the Director of the Bureau of Public Roads, United States Department of Agriculture, Washington, D. C., for assistance. Such applications will be considered by representatives of the Department of Agriculture, the War Department, the War Industries Board, the fuel administration and the railroad administration, and in accordance with the recommendations of such representatives, the Car Service Section will endeavor to furnish car supply necessary for approved essential road construction or maintenance.

It must be understood that car supply for stone, sand and gravel must not be permitted to jeopardize the essential production of coal, coke or ore. If at any time such a result is apparent on individual roads, or generally, orders will immediately issue to curtail the car supply for stone, sand and gravel.

Great Falls Power Again To Be Studied

Hydro-Electric Development on Potomac Above Washington Before New Governmental Committee

Development of power from the Great Falls of the Potomac, about 18 miles above the city of Washington, is once more being studied with a view to its possible use for governmental purposes at the capital. At the instance of Secretary McAdoo and with the approval of the Secretaries of War, the Interior and the Navy, a joint committee of engineers has been appointed to make an investigation of the situation and report on the most feasible plan of development. The committee comprises Brig. Gen. W. L. Marshall, consulting engineer of the Reclamation Service, chairman; Col. H. C. Newcomer, corps of engineers, U. S. A.; Civil Engineer A. L. Parsons, U. S. N., assistant chief of the Bureau of Yards and Docks, and N. S. Thompson, mechanical and electrical engineer, Supervising Architect's office.

A number of investigations of this project have been made in the past, notably that by Col. (now Maj. Gen.) Langfitt, corps of engineers, U. S. A., which was made the subject of a public document some years ago. Mr. Thompson was in charge of the steam power plant at Washington, the appearance of which was discussed so widely and which so disturbed the architects and city planners two years ago, and in his studies of the governmental power problem he was led to look very thoroughly into the Great Falls project as reported on by Col. Langfitt and others. It is at his instance that the Secretary of the Treasury has initiated the present investigation.

The committee is without funds or Congressional sanction, so it is probable that its work will consist mainly of the adaptation of old data to present conditions, although local reports, fostered by a Washington newspaper which has long favored the scheme, assume that field investigations will be undertaken. Unless some funds are diverted to the committee this seems hardly possible.

Colonel of American Engineers Gets British D. S. O.

To Col. J. N. Hodges, commanding the 6th regiment, U. S. Engineers, has been awarded the Distinguished Service Order by Great Britain, in recognition of the gallantry of his command in opposing the German advance during the battle of Picardy between Mar. 21 and Apr. 3. It has been announced by the War Department that Companies B and D, 6th U. S. Engineers, comprise the units of American engineers which played a prominent part in the defense put up by General Carey's improvised army, preventing the enemy from pushing through to Amiens in the first few days of the attack, as mentioned in *Engineering News-Record* of Apr. 18, p. 791.

These two companies of engineers served with the 5th British Army.

Massachusetts Will Operate Boston Elevated Railway

An act providing for state operation of the Boston Elevated Ry. Co. was passed by the Massachusetts Legislature, and was approved by the Governor May 24. It establishes a board of five trustees to manage and operate the property, adjust rates of fare to cover the cost of service, including specified dividend payments on the company's stock, and make improvements to the property. The trustees may appoint and remove the officers of the company, except the directors. Their acts are not subject to review by the Public Service Commission. The Legislature may terminate the period of state operation at any time after 10 years, on two years' notice.

Dividends on the company's common stock are fixed by the act at 5% during the first two years, 5½% during the next two years, and 6% thereafter, payable quarterly. An issue of $3,000,000 preferred stock by the company is stipulated in the act; the money so raised provides a $1,000,000 reserve fund for equalizing deficits or balances from operation, and leaves a sum of $2,000,000 to pay for improvements. The dividend rate on this preferred stock is to be fixed by the stockholders voting the issue, but may not exceed 7% (cumulative preferential).

Rates of fare are to be changed by the trustees whenever at the end of a quarter the reserve fund is found to be below 70% or above 130% of the original amount. When the reserve fund is insufficient to meet an operating deficit incurred, the state treasurer shall pay the difference and shall assess it upon the cities and towns in which the company operates.

The act will take effect only after acceptance by the stockholders of the Boston Elevated Ry. Co. and of the

West End Street Ry. Co., but such acceptance is considered likely. The vote of the company will, under the terms of the act, constitute an agreement to sell to the state or to any political division thereof, at any time during the period of public operation. The purchase price is to be equal to the cash paid in by stockholders for stock outstanding, and the company's current liabilities are to be assumed.

Illinois Adopts Highway Policy and Urges Maintenance

In answer to many inquiries and in accordance with patriotic principles, the Illinois Board of Public Works and Buildings, with the approval of Governor Lowden and the Board of Highway Advisors, has adopted the following highway policy for this year:

First, to carry on only such maintenance work as is necessary to preserve the roads already constructed under the direction of the department.

Second, to assist contractors, so far as possible, in the completion of contracts previously made by the department.

Third, to postpone the awarding and approval of new contracts for state-aid roads as advised by the Federal Government.

Fourth, to coöperate with the Federal authorities, so far as is possible under existing conditions, in the improvement of those Federal-aid roads which they have approved as being necessary for the transportation of war materials, food products and fuel.

In concluding the announcement, the board, consisting of Thomas G. Vennum, acting director, S. E. Bradt, superintendent of highways, and Clifford Older, chief highway engineer, urges township highway officials, in view of the present emergency, to make unusual efforts to keep the existing earth roads in good condition.

Phillipsburg Sewage-Works Further Delayed

Urging that the sale of bonds for sewage works would interfere with the third Liberty Loan drive, and backed by the Capital Issues Committee, the authorities of Phillipsburg, N. J., applied for a court order postponing the date at which that city must begin to construct sewage works in accordance with the decision handed down some time ago in the suit brought by the State Department of Health. Acting for the department, the attorney general contended that the sewage works were needed to help relieve the load on the Trenton water-filtration plant. After some hesitancy the chancellor ordered the matter postponed until June 18, but intimated that permission to defer construction would not be granted any longer than is necessary to meet war conditions. Two contracts for reconstructing a portion of the Trenton sewer have been let, but further contracts for this and for treatment works are necessary to comply with the demands of the State Health Department.

Paris Not Perturbed by Bombardment

Robert K. Tomlin, Jr., News-Record's War Correspondent, Tells How City Acts Under Fire

The first day of the bombardment of Paris by the long range German gun followed a night of bombing by enemy airplanes, says Robert K. Tomlin, war correspondent of *Engineering News-Record* in a recent letter. No one at that time realized that shells were being sent into the city from a point behind the front line trenches which are at least 75 miles from the center of the city. I was out on the streets the morning the bombardment began and everybody was under the impression that it was a *daylight* air raid, something entirely new, as of course all of the previous air raids had been engineered under cover of darkness. The sky above Paris was thick with French fighting planes, scooting here and there in search of enemy machines. It was not until late that day that we realized that the explosions did not come from bombs. The excitement was intense and everyone was mystified, for explosions were occurring at regular intervals of about twenty minutes, and no enemy machines could be spotted overhead.

Use Subway as a Refuge

The regular *alerte*, which is a warning sounded at the approach of German bombing machines, was given early in the morning, and both the "Metro" and the "Nord-Sud," the two Paris subways, were shut down in order that the stations, platforms and underground tubes could be used as a refuge by the people of Paris. The tramways, or street railways as we would call them, stopped operation. Cars were emptied, motormen and conductors left their platforms, and the rolling stock was left standing in the street wherever it happened to be when the *alerte* was given. Traffic was absolutely paralyzed and the only wheels turning were those of the taxicabs.

As a matter of fact, the shutting down of the subways in order to furnish underground retreats for the population defeated the very purpose for which it was done. In an hour or two people got tired of staying under ground and come up for a breath of fresh air. Many of them had to get from one part of the city to the other, and the only way of doing this was by walking along the streets. Therefore, with the subways shut down, there were far more people on the streets and subject to danger from explosions of shells than would have been the case if the lines had continued their normal operation. This fact evidently was appreciated later, for during succeeding bombardments by the long range gun, the subway system has continued in operation.

Taxicabs Have Harvest

In stopping traffic on the subway system on the first day of bombardment the officials made of Paris a regular bonanza for the taxicab drivers. These fellows were quick to realize their opportunity, and were charging double, triple, and quadruple their regular rates, and getting away with it, for there was not a vacant taxi to be had on that day. I know that I stood on the curb of the Rue de Rivoli for three-quarters of an hour, "hissing" at taxicab drivers —as this is the approved and, I think, well-justified form of signalling a vehicle here—but without result. I gave it up as a bad job, and walked to my destination which was almost three miles away.

Bombs Do Most Damage

The damage done by the long range gun is much less than that which results from the dropping of bombs by an airplane. I have seen a good many of the buildings hit by the long range shells and they seem to damage only the upper two stories. The bombs, however, wreck things to a greater depth, sometimes as much as four stories. It often happens that when a shell strikes, the panes of glass on the opposite side of the street are shattered, while those on the same side remain intact.

Detonations of explosives are such a regular event here that the storekeepers are going to great trouble to protect their windows from breakage. The favorite stunt seems to be to paste across the glass long strips of paper. It has been interesting to watch the development of this form of protection. Originally two diagonal bands were pasted across the window. Then someone with an artistic touch got busy and produced a design of squares and triangles like the strips of pastry on an old fashioned cranberry pie. He soon had a large following and now the windows present designs of every conceivable pattern. It seems to me that these Parisian shopkeepers have something to learn in the matter of window protection from New York merchants, whose stores were situated along the excavations for the new subway lines. There, it will be remembered, the favorite trick was to truss the panes with diagonal wires and struts at the center. I have yet to see one of these rigs in service here. The gummed strips of paper, however, apparently have official sanction for the windows of the *Ecole Nationale des Ponts et Chaussées* are "dolled up" in this way.

Shelters Provided by the City

The city authorities are busy providing shelters or *abris* for the people during air raids. These are generally cellars of buildings not less than four stories in height. On the entrances to buildings containing cellars which have been officially designated as *abris* are big paper placards indicating the capacity of the shelter. Going along any street in Paris now you see on the buildings these placards with the words "150 places," "80 places," etc. Some of the cellar *abris* had window gratings fronting on the streets. At the present time all of these are being blocked up with plaster to intercept shell splinters.

Although the subway is now kept running during daylight bombardment by the big gun, it is closed down during an

air raid at night. Those people who seek underground shelter on such occasions now take the experience pretty much as a matter of course, and during the last raid I saw people filing down stairs into the Etoile station of the "Metro" with camp-stools, chairs, newspapers and magazines, and other aids to comfort during the two or three hours sojourn below street level.

When a night air raid starts the fire engines are sent at full speed through the streets with their sirens going full blast, church bells outside of Paris start ringing, and factory whistles add to the discord. New stationary sirens are in course of installation. Pretty soon the anti-aircraft guns start booming on the outskirts of Paris and from my window I can see the flash of the shells as they burst in mid-air. It looks just like the bunch of sparks produced in grinding metal with an emery wheel. In twenty minutes or so after the guns have started the airplanes which have managed to break through the barrage begin to "lay their eggs." It is very easy to distinguish between the detonation of bombs and the burst of the shrapnel from the "Archies." The bomb makes a deep roar while the shrapnel produces a higher staccato note.

An American here where I am living arrived just in time to get in on one of the air raids. It was his first. The next morning he had a decidedly haggard look and I asked him what was the matter. He looked out of the window and seemed to be surprised that there was anything left of Paris. "They must have dropped about a thousand bombs last night," he said to me. I could not quite figure this out, as this was one of the nights that the bombing machines had failed to cross the barrage. Finally it dawned on me that he had assumed to be bombs the detonations of the hundreds of shells which had been fired by the French artillery on the outskirts of the city to form the protective barrage. No wonder he was upset, as there must have been a good many hundred shrapnel fired that night. If these had been Boche bombs I probably would not be writing this letter now.

Paris is not greatly disturbed by the shelling of "le canon à longue portée" which is generally dubbed by the French newspaper writers as "La Grosse Bertha." People go about their business very much as usual. The moving pictures are taking a fling at the big gun in a humorous way. At the last performance I attended there was shown an "animated cartoon" in which "La Grosse Bertha" was sending over shells and Charlie Chaplin (whom they call Charlot over here) was catching them, standing forth as the defender of Paris. After he had caught three of these the cartoon showed him juggling them, and finally hurling them back in the direction of Berlin.

While many persons have departed from Paris as a result of the air raids and bombardment, the bulk of the populace is taking the matter calmly. I have yet to see anything in the nature of a panic.

"Three Prize Members of a Company of Engineers—France"

Almost daily, *Engineering News-Record* receives from the Committee on Public Information lists of photographs of military subjects which are available for publication on request. These lists contain the titles and descriptions of the photographs, with their corresponding numbers. A few days ago we received a list including "No. 8394 — Three Prize Members of a Company of Engineers—France," and ordered the picture. Shortly afterward we received a photograph from the Division of Pictures, Committee on Public Information, Washington, D. C., bearing the number "8394," which is shown herewith.

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SERVING WITH THE ENGINEERS IN FRANCE

Indianapolis Buys Garbage Reduction Works

The garbage collection, hauling and reduction plants of the Indianapolis Reduction Co. have been bought by the city of Indianapolis, acting through its Board of Sanitary Commissioners. The contract for garbage collection and disposal, held by the company for six years, expired May 26. The contract price was $48,000 a year, with $1000 added for annexed territory. In December, 1917, the company was the only bidder for a new contract, the price it offered being $87,900. The commissioners advertised for bids for a collection and disposal plant. The company's bid was $175,000. The valuation placed on the plants by the commission's engineers was $179,645. The collecting and hauling plant consists of 65 wagons of 1½-ton capacity, 245 steel box beds and covers; 38 mules and 27 heavy draft horses; eight standard-gage 40-ft. railway flat cars; a loading station located about a mile from the center of the city, and some minor equipment. The reduction plant has a capacity of 145 tons of green garbage in 24 hours. It includes 16 digestors, a dryer, a percolator, various conveyors and four 150-hp. boilers.

Lincoln Highway Progresses

Despite the labor shortage, the high cost of material and other retarding influences, the officials of the Lincoln Highway Assn. estimate that about $5,000,000 will be spent in improving the route from the Pennsylvania-Ohio line to the Pacific coast. The figures for the different states follow: Ohio, $1,420,000; Indiana, $425,000; Illinois, $1,745,000; Iowa, $500,000; Nebraska, $105,000; Utah, $290,000; Nevada, $158,000; California, $140,000.

Permanent all-weather construction will absorb $3,920,000 of the above amount; graveling, grading, and bridge work will take $858,000; maintenance of the dirt sections in the middle west will cost an additional $500,000. If this program is completed, it will break all previous records of construction of the Lincoln Highway.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York; Spring meeting, June 4-7, Worcester, Mass.

NATIONAL MUNICIPAL LEAGUE; 703 North American Building, Philadelphia; June 4-6, New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS; 129 York St., Brooklyn, N. Y.; June 19-22, Berlin, N. H.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; University of Pittsburgh; June 26-29, Northwestern University, Evanston, Ill.

AMERICAN CONCRETE INSTITUTE; 27 School St., Boston; June 27-29, Atlantic City, N. J.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 25-28, Atlantic City, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS; 29 West 39th St., New York; June 26-28, Atlantic City, N. J.

The Technology Club, Syracuse, N. Y., elected the following officers for next year at the annual May meeting: President, Morris Dell Plain; vice president, C. C. Trump; secretary, Louis Mitchell; treasurer, Marshall B. Palmer.

The Engineers and Architects' Assn. of Southern California held a field excursion May 18. The trip was made

for the purpose of inspecting the 1000-ft. municipal pier being erected at Manhattan Beach and the new sewer outlet and pier which have just been completed at Hyperion.

The Society of Terminal Engineers elected the following officers at the meeting in New York City May 21: President, Maj. Gen. William H. Bixby, U. S. A., St. Louis; vice-presidents, Francis Lee Stuart, New York; B. F. Cresson, Jr., New York; John Meigs, Philadelphia; the Hon. Calvin Tomkins, New York and Charles Whiting Baker, New York; treasurer, W. Joshua Barney, New York; secretary, J. H. Leonard, 1133 Broadway, New York; directors, Charles Whiting Baker, W. Joshua Barney, Maj. Gen. W. H. Bixby, B. F. Cresson, Jr., Harwood Frost, Carlton Creene, H. McL. Harding, Hugh Hazelton, George H. Kimball, E. H. Lee, M. A. Long, S. H. Libby, John Meigs, R. H. Rogers, Francis Lee Stuart and the Hon. Calvin Tomkins.

The Society for the Promotion of Engineering Education will meet at Northwestern University, Evanston, Ill., June 26-29. The meetings of the society will be held in Swift Hall.

The Engineers' Society of Western Pennsylvania was addressed by George R. Johnson, district manager of the Foundation Co., Pittsburgh, on "The Caisson Method for Foundations and Mine Shafts" at the meeting held May 21.

The St. Paul Society of Civil Engineers held its last meeting of the season May 20. Oscar Claussen, chief engineer of the city of St. Paul, addressed the meeting on "Points On Force-Account Paving."

The Utah Society of Engineers held its annual banquet at Salt Lake City May 15.

PERSONAL NOTES

ARTHUR M. FIELD, city manager, Winchester, Va., has been granted a leave of absence for the period of the war to become connected with the engineering department of the Government bureau of industrial housing, Washington.

MAJ. HERBERT M. CROCKER, U. S. R., construction division, Quartermaster's Department, Washington, has been appointed constructing quartermaster at the South Brooklyn warehouse.

PROF. JOSEPH WILLIAM PARRY, acting head of the department of engineering extension, Iowa State College, has been appointed chief assistant to the executive head of the training section, Emergency Fleet Corporation. The training section provides for the instruction of workers in the shipyards of the Emergency Fleet Corporation.

GEORGE H. BENZENBERG has resigned as chairman of the Milwaukee Sewerage Commission, created a few years ago to build intercepting sewers and sewage-treatment works for Milwaukee. Mr. Benzenberg was for many years city engineer of Milwaukee; later he practiced as a consulting engineer.

L. M. FISHER, formerly assistant engineer, Pennsylvania State Health Department, has been appointed sanitary engineer, United States Public Health Service, in charge of malaria control work in the area surrounding Camp Meade, Maryland.

G. WATSON CREIGHTON, assistant to the engineer of tests, Bethlehem Steel Corporation, has been appointed assistant general manager for the Cast Steel Co. in Baltimore.

LEROY T. HARKNESS, chief of rapid transit, New York Public Service Commission, First District, has been commissioned major in the Department of Ordnance.

R. H. WIEDMAN has been appointed city engineer and water commissioner, Whitefish, Mont.

JAMES A. KINNEY, assistant director of public service, Grand Rapids, Mich., has been appointed city purchasing agent by Fred H. Locke, city manager.

HANS MUMM, JR., formerly engineer of Snohomish County, Washington, with headquarters at Everett, and later city engineer of Everett, recently opened an office in the Hutton Building, Spokane, as district representative of the Portland Cement Assn., in charge of the territory of Eastern Washington and the Idaho "Panhandle."

L. G. CURTIS, district engineer of the Baltimore & Ohio R.R. at Chicago, has been appointed assistant chief engineer, in charge of construction, with office at Baltimore. With the exception of one year, shortly after his graduation from Ohio State University in 1899, Mr. Curtis has been continuously in the service of the Baltimore & Ohio system since graduation. Beginning at Zanesville, Ohio, he was transferred to Garrett, Ind. in 1901 as assistant division engineer of the Chicago division. Two years later he was promoted to division engineer and his headquarters were transferred to Chicago. When the Baltimore & Ohio acquired the terminal and trackage of the Chicago Terminal Transfer Co., Mr. Curtis was put in charge of its engineering work, first as engineer maintenance of way and later as district engineer. His jurisdiction also extended eastward over a part of the Baltimore & Ohio proper.

FRED H. LOCKE has been appointed city manager of Grand Rapids, Mich., succeeding Gaylord C. Cummin, who resigned recently. Mr. Locke has served as director of public welfare of Grand Rapids since last fall.

CHARLES W. FINK has been appointed superintendent of dock construction for the Alaskan Engineering Commission. He was for five years on the Panama Canal work, including the Gatun locks.

T. W. SECREST has been appointed locating engineer on the Anchorage division of the Alaskan railways, under the Alaskan Engineering Commission, with office at Anchorage, Alaska. He succeeds F. D. Browne, assigned to other duties.

H. P. WARREN, for a year and a half Seattle representative of the Alaskan Engineering Commission, has resigned to accept a major's commission in the 55th Engineers, U. S. A. Major Warren played an important part in the construction of the Anchorage division of the Alaska R.R. As engineering representative in Seattle, he had charge of all of the commission's engineering problems there, as well as the direction of the railroad board's transportation operations and employment bureau.

FREDERICK D. BROWNE, formerly locating engineer in the Anchorage division of the Alaska Government railroad, has been made engineer in charge of the Fairbanks division.

C. E. LINDSAY, division engineer of the New York Central R.R. at Albany, has been made a member of the new Board of Railroad Wages and Working Conditions, created by the railroad administration "to hear and investigate matters presented by railway employees or their representatives affecting inequalities as to wages and working conditions."

EDGAR K. RUTH, assistant professor of civil engineering, University of Cincinnati, has received a captain's commission in the Engineer Officers Reserve Corps.

C. E. TILTON has been appointed city engineer of Phillipsburg, N. J.

LEROY C. SMITH, for several years deputy state highway commissioner of Michigan, has been engaged as chief engineer for the Wayne County road commission.

JOHN A. NORRIS, Wharton, Tex., was recently appointed a member of the Board of Water Engineers for the State of Texas, for District No. 2.

GEORGE C. BUNKER, in charge of water purification for the Panama Canal, has been engaged by the municipality of Lima, Peru, to investigate water supply.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Finance Board to Give Quick Aid to War Industries

A few applications for financial aid considered by the directors of the War Finance Corporation, at their first meeting held last week in Washington, D. C., appeared so urgent that loans may be made on them within the next week. Some of these applications are from concerns which have not been able to obtain loans from banks with which to increase the facilities of plants engaged in the production of war materials. At this meeting, the directors began the task of considering applications for financial aid to industries essential to the conduct of the war. Apparently under the belief that the War Finance Corporation is a source of easy credit for all kinds of projects, scores of persons and concerns applied for advances to aid them in promoting new enterprises which it was said would contribute to war work.

Various applications have been classified, and the directors of the corporation have undertaken to obtain full information on cases which appear meritorious. Applicants who did not present sufficient claims to justify immediate consideration were told to examine their cases in the light of the War Finance Corporation Act and to refile them if further evidence can be presented. Some applications on file reflect an apparent unwillingness of banks to extend credit to institutions which they have financed in the past without advance assurance of the War Finance Corporation that the loans will be covered by Government funds.

Supply of Asphalt for Paving Purposes Is Low

The shortage of asphalt for paving purposes, which was recently emphasized by a new Government order, has two general causes—shortage of transportation, and Government regulations. The Government regulations controlling were published in this journal last week.

The greater portion of the asphalt used in the country comes either from the Trinidad and Venezuela supplies, or from Mexico and the oil supplies along the Gulf Coast. The freighters which generally carry the supply of hard asphalt from Trinidad and Venezuela have been taken over, and are being used for war transportation. The large tankers, which brought the liquid asphalt from the Gulf Coast, are being used chiefly to transport fuel oil for our navy and the navies of our Allies.

Moreover, it has been found necessary to conserve the fuel oil supply to the utmost, and the Government is encouraging the production of oil for fuel purposes instead of for asphalt. In order that this may be controlled, the Federal authorities are requesting that all asphalt and oil products be handled by permit. A committee has been formed, representing all the large oil and asphalt interests, which meets once a week at 42 Broadway to confer with C. G. Sheffield, assistant to Mark L. Requa, director of the oil division of the fuel administration. At this meeting Mr. Sheffield brings forward and explains the Government needs, explains where the shortage is at the present time, and asks who can supply the need. The order is divided among those companies able to furnish the oil, and permits are issued for its shipment. The Government has found it necessary to conserve the fuel oil supply, not only because of the present demand, but also because practically all the boats being built by the Emergency Fleet Corporation will use oil as fuel.

Price of Soft Coal Reduced by Presidential Order

The mine price of soft coal has been reduced 10c. per short ton, effective May 25, under the terms of an order dictated by President Wilson, which also requires the railroad administration to pay the Government rate instead of prices considerably less than those fixed for other consumers, as previously. The reduction in price also covers all orders for coal placed but not filled before 7 a.m., May 25.

It is estimated that the new schedule will save consumers about $60,000,000 annually, while it will add $45,000,000 to the expense of operating the railroads, which the order requires to maintain equitable distribution of cars to all mines rather than favor a few of the mines.

It is believed that the new system for car distribution will reduce the production costs on which the old schedule of prices was fixed. A study of the developments will be made to determine whether further changes must be made. However, the present order stands until Aug. 31.

Course for Factory Managers at Columbia University

Columbia University will offer a course in organization and management, to be open to technical men employed in managerial posts next fall, according to an announcement made by the department of extension teaching. The course will be given under the direction of Prof. Walter Rautenstraugh, consulting engineer at several industrial plants. It will be essentially a study of manufacturing and will embrace commercial as well as technical problems.

Summarize Difficulties Attending Unprecedented Lumber Demand

The present unprecedented demand for all sizes and grades of lumber was emphasized by R. B. Goodman, acting president, at the annual meeting of the National Lumber Manufacturers' Assn., held in Chicago, May 20-21, announced in *Engineering News-Record* of May 2, page 887. Mr. Goodman also pointed out that in every step of the manufacture and marketing of lumber there are now unprecedented difficulties; that other necessary supplies, particularly steel products, are rapidly going out of the domestic markets. The demand for labor has outrun the supply and higher prices paid for it do not increase the supply or better the quality.

In commenting on the difficulties of the industry caused by the transportation situation, Mr. Goodman said: "While the regular and continuous supply of cars for transporting our product is essential to the regular and continuous operation of our plants, such supply is now impossible, and the industry must suffer from the misadjustment of a shortage from July to April that will seriously affect operating conditions. Of course this is a situation that will adjust itself or be gradually adjusted for us. The steel is needed for government uses; the labor is depleted by war necessities; the cars are needed for transporting fuel, food and munitions, but it is becoming apparent to those in authority that lumber is also a war necessity to the last board in the log. We may easily go on about our business and allow the situation to unfold. There is in it some certainty of profit."

That the public sentiment of the country with regard to industry is drifting toward Government ownership of public service corporations, and probably of natural resources, with confiscation of private property for public use, was pointed out in a paper, presented by Charles S. Keith, which analyzed economic conditions and tendencies reflected in various branches of industry. Mr. Keith's address included also the following remarks:

"The demand of labor, as expressed by the British Labor party, which will no doubt be concurred in by organized labor, includes: Universal enforcement of a national minimum wage; democratic control of industry; revolution in national finance, and surplus wealth for the common good. This should awaken us to the gravity of the situation and the necessity of coördinated effort to meet it, not only in our industry, but in all business."

Briefly stated, Mr. Keith's outline of some of the things essential to solve the problems of the lumber industry are as follows: To ascertain—not to guess at or estimate—every fundamental fact about the industry; to bring about effective coöperation between all industries dealing with natural resources, in order to expose the fallacies which underlie the apparent tendency of public opinion to regard the owners of such resources as unworthy to remain custodians thereof; to educate the public about the industry by propaganda of facts; unceasingly to study the trend of public opinion.

Division of Inspection Organized to Insure Clean Coal

The fuel administration has organized a division of inspection, with C. M. Means as manager, to guard against waste and serious loss such as that which resulted last winter from shipments of dirty coal, which occupied car space and also seriously decreased industrial plant efficiencies. A chief inspector has been appointed in each of 21 representative districts and assistant inspectors will be added where necessary. These inspectors will examine coal in the mines and also as dumped from mine to tipple; watch the picking tables, and again inspect the coal as it is loaded in cars for shipment.

Standards will be established for insuring proper preparation according to use, so that all coal shipped must be of the quality required for its particular purpose. By examining coal at the mine a great improvement in the transportation situation should result, in that the railroads will in effect haul heat units, not ash.

Miners who get out dirty coal will be penalized and a bonus system is being developed. Mines that cannot supply properly prepared coal will not be allowed to ship by rail.

War Materials Carried by Trucks in Record Overland Run

Records in overland freight transportation by motor trucks are being rapidly made and as rapidly broken in these days of difficult rail transportation. Necessity is rapidly extending the use of motor vehicles for service at longer and longer distances.

What is said to be an astonishing feat has just been performed by a company of five loaded motor trucks in making the run from Akron, Ohio, to Chicago, a distance of 440 miles, in 35½ hours running time. A regular schedule was maintained over the entire distance, following the Lincoln Highway.

The trucks were unloaded over night in Chicago, received a new consignment of urgently needed government supplies, and started east again the next morning. The goods, which had been held in Chicago for several weeks because of poor railway transportation, were promptly delivered at an Atlantic coast port.

The trucks used in making this run form a unit of the Akron-Boston fleet of the Goodyear Tire and Rubber Co. of Akron, Ohio.

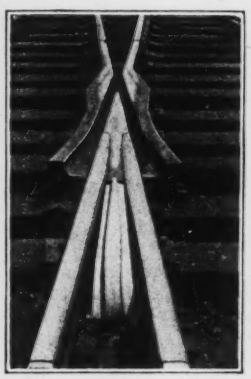
Pacific Coast Oil Supply May Be Exhausted Within a Year

Even with the most careful economy the oil stored on the Pacific coast will be exhausted within a year, and the curtailment of consumption may be expected within six months or less, according to a statement recently made by D. M. Folsom, Pacific Coast petroleum administrator. There has been a decline in drilling operations thus far this year of 40 per cent., as compared with last year.

All fuel consumers will probably be classified, and only those entitled to priority rating will be supplied with oil. In the case of companies which use oil for generating power, the oil supply will be continued only if consumers served are entitled to priority rating, the burden of proof being placed on the power companies.

Device Replaces Cars Derailed at Switches and Frogs

A rerailer device for use at switches, frogs and guard rails, where the ordinary rerailing device may not be applicable, is shown in the accompanying illustration. It is a steel casting of tapering form, which can be fitted between the rails. Its inclined surface raises the wheel and has a rib for guiding the wheel into position. The casting is 30 in. long and 2½ to 5½ in. wide, and can be used with rails up to 6½ in. high. It weighs 77 lb. These castings are used in pairs. When in place the casting rests on the bases of the adjacent rails and it requires no spikes or other fastenings to secure it. These rerailers for cars and locomotives are made by the Reading Specialties Co., Reading, Pa.



Large Amounts of Lumber for New Government Barges

It is expected that the lumber industry will shortly be called upon to furnish nearly 100,000,000 ft. of lumber and timber for the construction of 150 wooden barges which the Government has decided to build at Atlantic coast and gulf ports to increase coastwise transportation facilities. These barges will be of 2200 to 3500-ton capacity each. The barges of larger size call for 700,000 ft. of lumber each.

National Coal Association Holds Meeting in Philadelphia

The National Coal Assn. met in Philadelphia on Tuesday and Wednesday of this week. The first day was devoted to the business of the association, and Wednesday Chairman Hurley of the United States Shipping Board delivered an address on the difficulties of ship construction and maintaining transportation to the Atlantic seaboard, with reference to the importance of the coal situation to the shipbuilding program. J. A. B. Morrow spoke for the first time on the plans for the distribution of coal in 1918, in working zones. A. W. Calloway, of the bituminous district, spoke on the same subject. James B. Dickinson, chairman, anthracite district, spoke on distribution.

OBITUARY

Frederick H. Siegfried, founder and first president of the Siegfried Co., advertising agents, New York City, and previously business manager of *Engineering Record*, died May 26 at Redlands, Cal., in his forty-third year. Mr. Siegfried was one of the charter members of the New York Advertising Agents' Assn., and served as its first secretary and treasurer. He was born in Louisville, Ky. He was formerly a member of the staff of *The Boston Herald* and of *The New York Herald*.

BUSINESS NOTES

Harry F. Ensley has resigned as vice president of the Wharton and Northern R.R., a subsidiary of the Wharton Steel Co., to confine himself entirely to duties as chief counsel of both companies. L. E. Waring becomes vice-president of the railroad and assistant to the president, Wharton Steel Company.

Murray Jacobs, sales representative of manufacturers of shipbuilding materials, steel products, waterworks materials, etc., has moved his offices from the Arcade Building to the L. C. Smith Building, Seattle. Among other companies, Mr. Jacobs represents the following: American System of Reinforcing, Chicago; Belmont Iron Works, Philadelphia, and Kennedy Valve Manufacturing Co., Elmira, N. Y.

The general contracting firm of Kieburtz & Smith, Seattle, which has been engaged in the contracting business in the Northwest for a number of years, has been dissolved. G. J. Kieburtz will continue in business at the old office in the Railway Exchange Building. F. Richmond Smith will maintain offices in the same building.

M. H. Sigafoos has been appointed general manager of the Hazard Manufacturing Co., Wilkes-Barre, Pa., filling the vacancy created by the death of John C. Bridgman last May.